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9 April 1982

# USSR Report

CONSTRUCTION AND EQUIPMENT

No. 60

TECHNICAL LEVEL OF MACHINE TOOLS

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USSR REPORT  
CONSTRUCTION AND EQUIPMENT

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## TECHNICAL LEVEL OF MACHINE TOOLS

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## METALWORKING EQUIPMENT

### PROBLEMS OF MACHINE TOOL INDUSTRY

Novosibirsk EKO in Russian No 1, Jan 82 (signed to press 14 Dec 81) pp 23-46

[Article by Professor S. A. Kheyman, doctor of economic sciences, member of EKO editorial board, Institute of Economics of the USSR Academy of Sciences, Moscow: "Metal-Working Equipment: Technical Level and Competitiveness, The Industrial Organization of Machine Building and Machine-Tool Manufacture"; passages enclosed in slantlines printed in boldface]

[Text] The decisions of the 26th CPSU Congress devote an enormous amount of attention to machine building and metalworking. They set the tasks of accelerating the development of these industries, reequipping the machine-building industry with new metalworking equipment and improving the structure of the machine-tool inventory. Joint sessions of the commissions on industry of the Council of the Union and the Council of Nationalities of the USSR Supreme Soviet held in 1980 and 1981 have been devoted to machine building and machine-tool manufacture.

Why has the problem of the development of machine building and its core component, machine-tool manufacture, just now become a particularly urgent one? Intensification of our national economy requires sharp improvement in the level of equipment of all branches. At the same time, as pointed out in the decree of the CPSU Central Committee and the USSR Council of Ministers, "Substantially raising the technical level and increasing the competitiveness of metalworking, casting and wood-processing tools and equipment," despite the important advances achieved in Soviet machine-tool manufacturing, technical improvement within the industry is not proceeding at the required pace.

Our magazine has dealt with machine-tool manufacturing more than once. We have looked at the organization of the production of machine tools with numerical programmed control and discussed the experience accumulated by the Krasnyy proletariyy plant, which came out during the Tenth Five-Year Plan period with the initiative "First-rate equipment for a five-year plan of efficiency and quality." We have thought it appropriate to come back to the subject of machine-tool manufacture in view of the fact that the matter of raising the technical level and increasing the competitiveness of metalworking equipment during the Eleventh Five-Year Plan is coming to acquire a particularly vital importance.

Excellent metalworking equipment--this means a higher class of motor vehicle and aircraft, extensive possibilities for development of the most complex radio-electronics

and instrument-manufacturing technologies, reliability in tractors and combines, improved domestic services etc. All this foreordains the greater requirements to be imposed upon machine-tool manufacturing, upon the structure of the equipment it turns out and upon its technical level.

It would hardly be proper if we were to be acquiring many types of equipment abroad instead of developing a capability for manufacturing these items ourselves. Participation in an international cooperation of labor is, of course, a progressive thing and in certain instances necessary, but only to the extent to which it is advantageous for the national economy. Important as well is the fact that excellent equipment means a possibility of manufacturing high-quality finished products and then selling them on the foreign market.

We open our selection of material with an article by Professor S. A. Kheyman, Doctor of Economic Sciences and a member of the magazine's editorial board, which will introduce the reader to the range of basic problems confronting our machine-tool manufacturing. A special round-table session has been devoted to a detailed discussion of these problems. Participants in the discussion showed great interest in the operation of the Ivanovskoye Machine-Tool Manufacturing Association imeni 50th Anniversary of the USSR, whose experience is discussed in the article by the association's general director, V. P. Kabaidze. In view of the pointedness with which the question of tool supply has been raised, the editors have given opportunity for comment by D. I. Semenchenko, Candidate of Technical Sciences and deputy director for scientific work of the All-Union Scientific Research Institute of Tool Manufacturing.

VAZ [Order of the Red Banner of Labor Volga Motor Vehicle Plant imeni 50th Anniversary of the USSR] representatives were unable to participate in the round-table discussion, but they have formulated their suggestions for improving equipment supplies in a separate article. Officials from Gosplan USSR and the USSR State Committee on Science and Technology have given the magazine an interview dealing with questions raised in the course of the round-table discussion.

Publication of this material does not conclude the discussion of the technical level and competitiveness of Soviet equipment. We hope to see it continued in readers' letters and new articles. For there are so many aspects to the problem!

[Article by S. A. Kheyman] The realization in production of new equipment and technology and the technical equipment of material production along with the non-productive sphere and our everyday lives depends to a decisive extent upon machine building. The product of machine building--its quantity and quality--is in turn to a very great determined by the structure and technical level of its production organization, which is a creation of machine-tool manufacturing and upon which the equipment of the machine-tool industry itself depends.

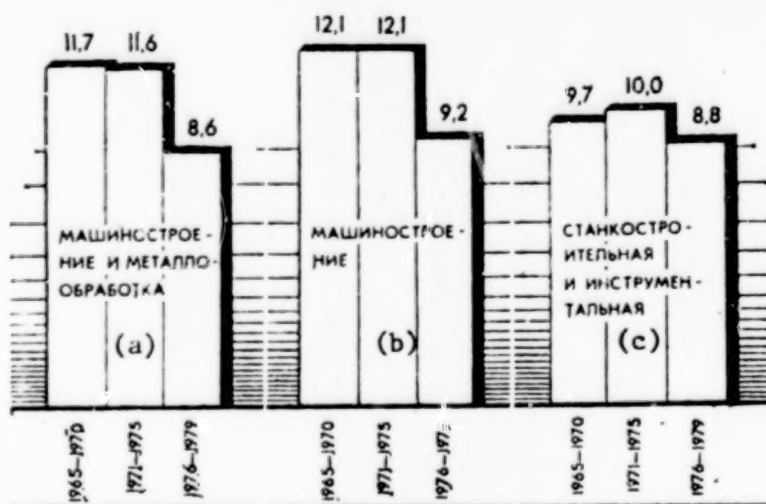
The tasks of the 1980's, formulated by the 26th CPSU Congress, and the challenges of the 90's--/"it is over precisely this period,"/ declares the CPSU Central Committee report to the 26th Congress, /"that we will be laying the foundations and erecting the economic structure with which the country will go into the 21st century"/--will require critical analysis and completion of each phase along the way as well as of the programs involved as a whole.

The party central committee and government are devoting great and unwavering attention to machine-tool manufacturing. Evidence of this is to be seen, among other things, in the decree "Substantially raising the technical level and increasing the competitiveness of metalworking, casting and wood-processing tools and equipment" adopted by the CPSU Central Committee and USSR Council of Ministers at the beginning of 1980 and the conference of machine-tool industry officials held with the CPSU Central Committee on 10-11 March 1980.

This led to the preparation for publication in our magazine of materials from the round table and a selection of articles dealing with problems in the machine-tool industry.

Prerevolutionary Russia had virtually no machine-tool industry of its own; this industry was developed during the period of industrialization spanning the three prewar five-year plans. The year 1940 saw the manufacture of 58,400 metal-cutting machines (as compared with 1,800 in 1913) and 4700 forging and pressing machines (these were not being produced in 1913).

Despite the destruction of major industrial centers during the Great Patriotic War and the evacuation of a number of key machine-tool plants, 1950 was already seeing machine-tool production substantially exceed prewar levels--70,600 machine tools and 7700 forging and pressing machines (FPM). Machine-tool output has more than tripled over the past 30 years and reached 230,000 in 1979; in terms of value, machine-tool production has increased more than 20-fold, taking into account the most important qualitative improvements in the construction of the equipment; FPM output has risen 7.3-fold (56,300 units in 1979), 35.5-fold in terms of value. From 16 units in 1960, the output of machine tools with numerical programmed control rose to 8800 units in 1980. In terms of the number of machine-tools with numerical programmed control (NPC) manufactures, the USSR has taken over first place worldwide. Production of automatic and semiautomatic machine-building and metalworking lines rose from a single line in 1940 and 10 in 1950 to 174 in 1960, 579 in 1970 and 801 lines in 1979.



Statistical illustration. Average annual rates of growth in total production by branches of industry: a - machine building and metalworking; b - machine-building; c - machine and tool manufacturing.



This has made possible a rapid growth in the metalworking equipment inventory of the country as a whole as well as of the machine-building industry (its production apparatus). By 1980 it had substantially exceeded in terms of number of units the US machine-building and metalworking inventory, while the total inventory in our national economy had surpassed the inventory of metalworking equipment then in operation in all branches of the US economy plus the combined inventories of this equipment in the machine-building and metalworking industries of Japan and the FRG.

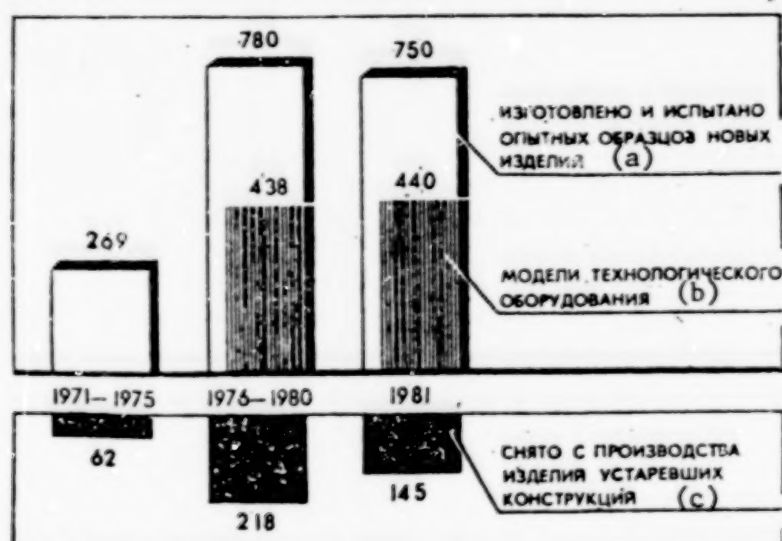
The output of equipment on these scales and the creation of this enormous inventory of machine tools and forging and pressing machines constitute a truly heroic feat on the part of workers in the machine-building industry and branches associated with it.

But in this connection we cannot fail to take note as well of the fact that the production of our domestic machine-tool industry has to a considerable extent formed and continuously expanded the "machine-building sector" of an enormous natural economy existing and even growing in all branches of our economy. Over the period we have under consideration here, 1962-1980, the inventory of metal-cutting machines in this "sector" grew 2.6-fold, that of pressing and forging machines 2.9-fold, 2.65-fold overall, more rapidly, that is, than the equipment inventory in machine-building and metalworking themselves (2.37-fold). To characterize the scales of this extramachine-building inventory of metal-cutting equipment it is enough to mention the fact that by the beginning of 1980 it comprised 44 per cent of the country's metal-cutting machines and 42 per cent of its FPM inventory. The number of machines involved here was greater than that making up the entire US inventory of machine-building and metalworking machines. This is evidence of the sharply increased capacities of our domestic machine-building industry (and metallurgy as well) and at the same time an indication of the problems remaining unresolved in the organization of our social production.

Substantial shifts have occurred in the structure of the production organization of the machine-building industry. The proportion of forging and pressing machines has increased. There were 17.2 per 100 metal-cutting machines in 1962, 20 by the beginning of 1980. TsSU SSSR [USSR Central Statistical Administration] unfortunately takes only very infrequent equipment inventories (1958, 1962, 1972 and 1981. The results of the last one have still to be published). We are therefore able to evaluate these shifts for only a 14-year period (1958-1972). They are entirely progressive in nature. The proportion of machines removing chips (lathes, planers, slotters and broaches) decreased from 36.2 to 33.7 per cent, while that of surface grinders increased from 14.1 to 16.5 per cent. The share of lapping and finishing equipment (honing, lapping and polishing machines), however, dropped from 2.9 to 1.9 per cent. The proportion of the most advanced types of equipment employed in electrophysical electrochemical working (first included in an inventory in 1972), unit machines and automatic lines rose from 0.6 to 1.6 per cent. The number of the latter in machine building and metalworking rose from 2965 in 1965 to 12,912 as of 1 July 1979, that is, 4.35-fold. Still another important result is the fact that by the beginning of 1980 the USSR counted some 70,000 units of equipment with programmed control (for the most part in machine building).

Despite all these clear-cut successes, the technical level and technological structure of the production apparatus of our machine-building industry in many respects still do not measure up to present-day requirements and potentialities, which naturally raises a number of most urgent problems requiring solution by the machine-tool industry and allied branches--the electrical equipment, instrument making and electronics industries.

Speaking at a conference of machine-tool industry officials in March 1980, Comrade A. P. Kirilenko, Politburo member and CPSU Central Committee secretary, declared: "Despite substantial advances, however, our technical progress in machine-tool manufacturing is still too slow. The structure and quality of the metalworking equipment manufactured by Minstankoprom [USSR Ministry of the Machine-Tool and Tool Manufacturing Industry] enterprises are far from fully measuring up to the tasks of introducing into the machine-building industry the advanced technological processes insuring the greatest growth in labor productivity, an increase in metal use coefficient and improvement in the quality of the machine-building industry product."<sup>1</sup>



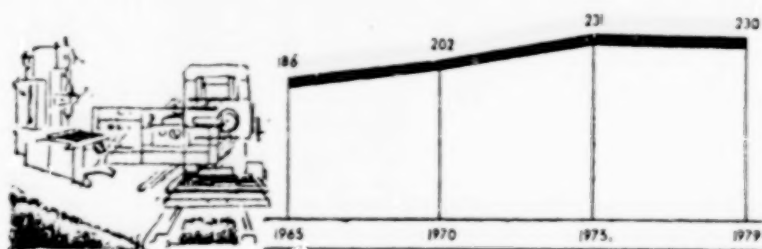
Statistical illustration. Production of new and the discontinuance of obsolete component designs in the machine-tool and tool-manufacturing industries in average number of items per year: a - prototypes of new components fabricated and tested; b - models of production equipment; c - components of obsolete design removed from production.

First, the /structure of the inventory/. Worthy of attention in this connection is the overall ratio between metal machining (and, accordingly, the inventory of metal-cutting machines) and the use of plastic deformation and welding (pressing and forging and welding equipment).

The ratio between metal-cutting and pressing and forging machines in the USSR in 1962 and 1980 was 100:17.2 and 100:20. The corresponding ratio for the US in 1963 and 1978 was stable at 100:31.4, that is, a more favorable and economical ratio. The analogous ratio for Japan in 1973 was 100:31.9, for the FRG in 1976 100:25.5 and for Great Britain (far from being among the leaders with respect to levels of equipment and technology) in 1976 100:21.6. The Soviet lag in the introduction of stamping and welding methods has its roots outside the realm of machine building--in the small proportion of sheet steel (and of thin sheet in particular) in the output of rolled metal products and the predominance, closely interrelated with this, in

equipment component design of an orientation toward solid rolled sections and casting. This distorts the structure of the machine-building production organization; increases the proportion of cutting and chip-removing machines and, accordingly, reduces that of finishing equipment; increases metal waste, adds to the weight of equipment and increases both the labor and capital intensity of machine building.

This cluster of problems requires an integrated solution. It will involve the simultaneous and well-planned reorientation of design development and equipment production technology in the direction of extensive substitution of the thinnest possible sheet for castings and solid rolled steel, an increase in machine building itself, radical improvement in the quality of rolling equipment for the production of sheet of the required characteristics and increased output of up-to-date pressing and forging and welding equipment and correspondingly limiting the production of metal-cutting machines.



Statistical illustration. Production of metal-cutting machines in thousands of units.

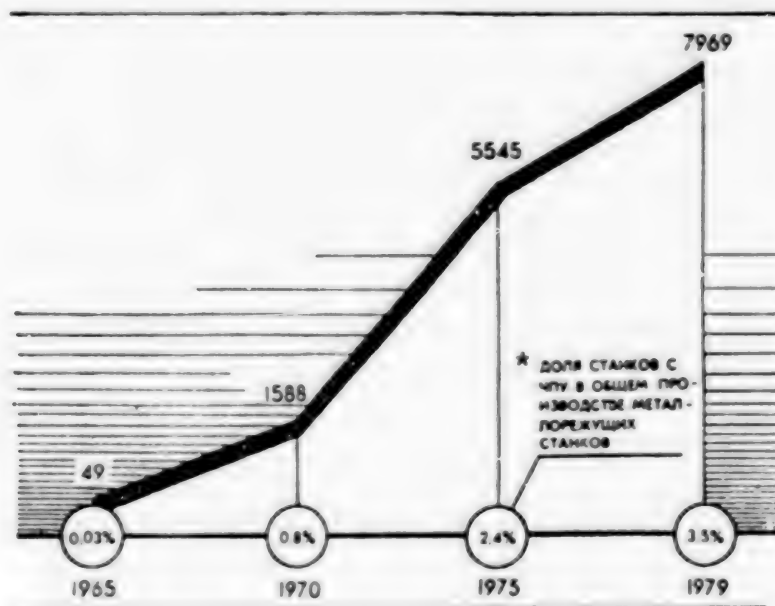
Some of the general trends in the structure of the US machine-building equipment inventory are worthy of attention. The number and proportion of machines for molding articles from plastics increased 4.11-fold between 1963 and 1978, that of pressure casting machines 2.04-fold. Their share in the overall inventory of all types of machines increased from 0.39 to 1.22 per cent--more than 3 times. Production of control and measuring machines and equipment not included in the 1963 inventory also increased, 21 per cent between 1968 and 1978, the percentage of this category from 1.55 to 2.02 per cent.

Finally, the most recent inventory (1976-1978) showed the US machine-building and metalworking industries to dispose of 925 laser machines (not counting measuring equipment employing laser technology) and 1623 industrial robots (manipulators). This means 3.04 lasers and 5.35 robots for every 10,000 units of machine-building and metalworking equipment. That comes to 3.53 and 6.15 per 10,000 units of equipment in enterprises employing 100 workers or more, 0.97 and 2.04 respectively for small enterprises with 20-49 workers. It is obvious that the statements of some Soviet scientists concerning the "laser era" and a "robot era" in connection with the US machine-building industry are as yet clearly exaggerated, which in no way detracts from the great promise held out by this technological product of the epoch of the scientific-technical revolution.

/Improvement in the structure of the production organization of the machine-building industry will require improvement in the ratio of machines producing the bulk of the

chips to finishers turning out high-precision pieces (grinders and surfacers)./ According to data from the 1972 inventory, for every 100 machines in the first category (lathes, planers, slotters and broaches) the USSR had 29.7 grinders (not counting bench grindstones, rough grinders and tool-grinding machines) while the US had 49.5; the USSR had 5.9 finishing machines, the US 30.3. This characteristic of the structure of the production apparatus has a substantial impact upon the characteristics of the equipment to be fabricated and, consequently, upon the very same characteristics of the final product turned out by this equipment.

The explanation for this is to be sought not only in the structure of the equipment inventory itself. We have to consider two other situations. First, the predominance of cast billets and merchant bars, which dictates a large role for cutting technology



Statistical illustration. Production of machine tools with numerical programmed control. \* - percentage of machines with numerical programmed control within total production of metal-cutting machines.

and associated equipment. Second, the comparatively limited number of rolled shape dimensions (2-3 times smaller than in the US or FRG). The exceedingly inadequate output of precision rolled shapes approximating in their dimensional parameters the final product to be fabricated from them constrains the removal of large volumes of chips and so requires "chip-producing" machines. Accordingly, the problem must also be solved in conjunction with the machine-building, metallurgy and metallurgy machine-building industries.

The piece rolling mills already being manufactured in the USSR are highly promising in this connection. The decisions of the 26th CPSU Congress contain the following:

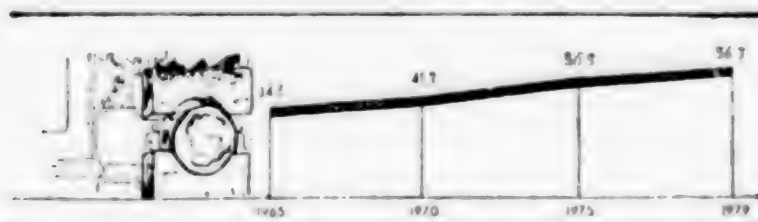


"Fabricate piece-rolling mills, which permit the use of rolled metal stock with a minimum of waste scrap, and introduce them into the production operations of machine-building enterprises."

/Another important problem has to do with the proportion of the most advanced category of machines: standard-unit and multifunction machines, automatic lines and automatic assembly machines./ In 1972 the proportion of machines in this category in the USSR was 1.19 per cent; the figure for the US over the period 1976-1978 was 2.93 per cent. Electrophysical and electrochemical machines accounted for 0.4 and 0.6 per cent respectively.

The structure of the metalworking equipment inventory outside the machine-building industry remains considerably still less advanced. At the same time our machine-tool industry is being constrained to employ a substantial portion of its own capacities to produce the relatively primitive machines it needs but which impose much lower requirements for product quality and production standards.

/Any characterization of the production apparatus of our machine-building industry would be incomplete were we not to include a characterization of the rate at which it is being modernized./ The portion of equipment removed from the operational inventories of the USSR's machine-building and metalworking industries due to wear and

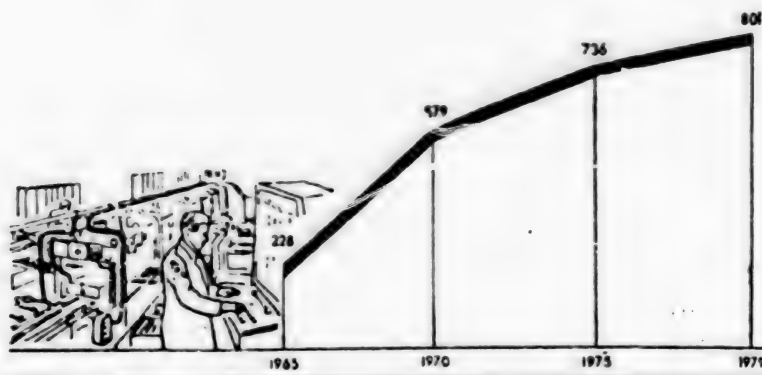


Statistical illustration. Production of forging and pressing machines in thousands of units. Note: Automated pressing and forging equipment accounted for 18.5 per cent of the total figure in 1975, 25 per cent in 1980. The plan calls for this figure to rise to 45 per cent in 1985.

Modernization was 2.1 per cent in 1973 and 1975 and 2 per cent in 1979. According to data presented in the course of the roundtable discussion by A. Ye. Prokopovich, USSR Deputy Minister of the machine-tool and tool-manufacturing industry, annual replacement figures in 1980 were 2.7 per cent for the USSR, roughly 5.5-6 per cent for the FRG and around 8-9 per cent for the U.S.

The low level of replacement is not compensated by the scales of modernization. Over a period of 4 of the years of the Tenth Five-Year Plan, 1 per cent of the equipment in the entire production equipment inventory of the machine-building and metalworking

industries was modernized. As can be seen from data published by the TsSU, the scales of modernization over the years of the Eighth, Ninth and Tenth Five-Year Plans did not increase, but on the contrary even decreased, taking the growth of the overall inventory into account. In this connection we should take into consideration the fact that we are now, as a rule, modernizing without participation in the effort on the part of the plants manufacturing the equipment involved, but rather on an in-house basis, ordinarily in the shops of the chief engineer's department, to a certain extent amateurishly and without participation by the principal bearers of technical progress in the production of that particular type of equipment.



Statistical illustration. Production of automatic and semi-automatic lines for machine building and metalworking in complete units.

What with the enormous scales involved in our machine-building inventory (and, incidentally, in that of many other branches as well), it is beyond the capacity of our economy to modernize it by equipment replacement alone. /The time has now come, in our view (and we talked about this during our roundtable discussion), to provide for the modernization of many types of equipment right in the process of designing a model for development./ This would strengthen the ties between the manufacturers and the purchasers of the equipment, increase the responsibility of the manufacturers and, most importantly, raise the technical level of the modernization and make modernized equipment as nearly like equipment that is in fact new.

The material published in this issue of EKO has shed light on a number of important problems having to do with the technical level of our machine-tool industry and its products as well as with the functioning of our machine-tool manufacturing industry overall and in its inter-relationship with the machine-building industry. The conditions and standards prevailing within the entire machine-building industry depend to a very great extent upon the tool industry. This is where the "tone" must be set, the "style" dictated. To a great extent the machine tool and its technical equipment is the culture bearer here. All problems are looked at from the point of view of these high requirements.

/We need to adopt an integrated, systems approach to evaluation of the technical level of a machine tool./ The capacity of a machine--the magnitude of the forces

involved, the effective rate at which the working implement (tool) acts upon the object of labor (the billet), the dimensions of the billets and pieces which can be worked and fabricated on it--all these factors are highly important characteristics of its technical level. To a very great extent they will be functions of the level at which the machine is equipped with regard to its various components--motors, drives and control devices, items which are fabricated outside the machine-tool industry, that is, by the electrical equipment, electronics and instrument-making industries. It is of course obvious that the most important component of a machine's technical level is the extent to which its operation has been automated.

What we are principally talking about now are those integral components of the modern machine machine tool which many times raise its technical level and increase the efficiency with which it can be employed--its electrical and electronic components and hydraulic and pneumatic systems.

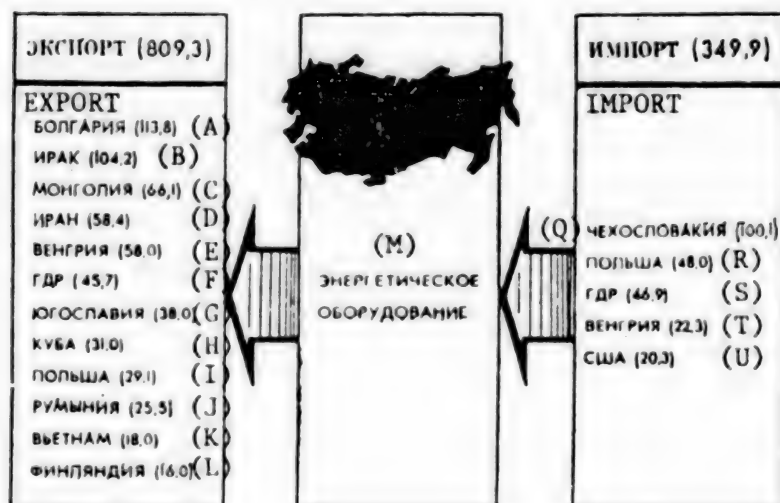
At the same time, of greatest importance are the conditions and economies characterizing the operation of a machine, its reliability, that is, its economically advantageous lifetime.<sup>2</sup> Today's machine tool must be equipped with an essential number of control and measuring devices (measuring and controlling not only the dimensions of the articles or semifinished items being fabricated, but the technical state of the working tool itself), diagnostic and loading and unloading equipment, a complement of working tools and operating equipment and, if necessary (in machines with NPC), the required amount of program "software."

Reliable, trouble-free operation will require a complement of replacement and repair units and parts (or component and assemblies necessary to modernize the machine), which the manufacturer should supply the customer for the entire operating lifetime of machines of the particular model involved.

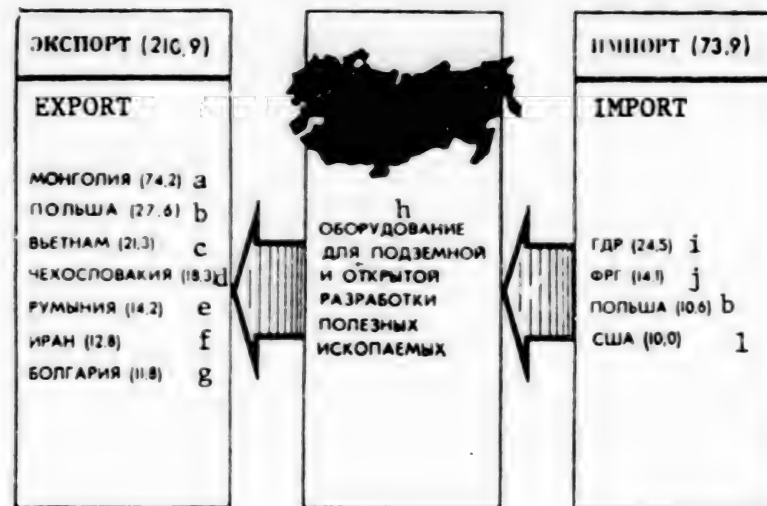
The material published in this issue indicates that all this is now far from always being the case. If we are to speak of factors external to the machine-tool industry, it should be said that despite all the decisions which have been adopted, the electrical equipment, electronics and instrument-manufacturing industries are still failing badly to meet the requirements of the machine-building industry in either quantitative or qualitative terms. Nor, as many writers have pointed out, can we easily expect any fundamental improvement in the situation over the course of the Eleventh Five-Year Plan period. This will entail the expenditure of billions for the import of many types of machine tools, pressing and forging machines and lines, which are particularly necessary for the priority branches, as well as for the import of components and units in short supply. According to the evaluation of specialists, domestically manufactured programmed devices are lagging behind in their level of technical development. They can be characterized as having an inadequate range of functions, only small degrees of integration, poor reliability, large dimensions and high cost.

Consequently, almost half of the "working center" type of multitool machine with NPC manufactured in Soviet machine-tool plants are equipped with imported components.

A sharp reorientation of the electrical equipment, electronics and instrument-manufacturing industries in the direction of the needs of machine-tool manufacturing is clearly required.

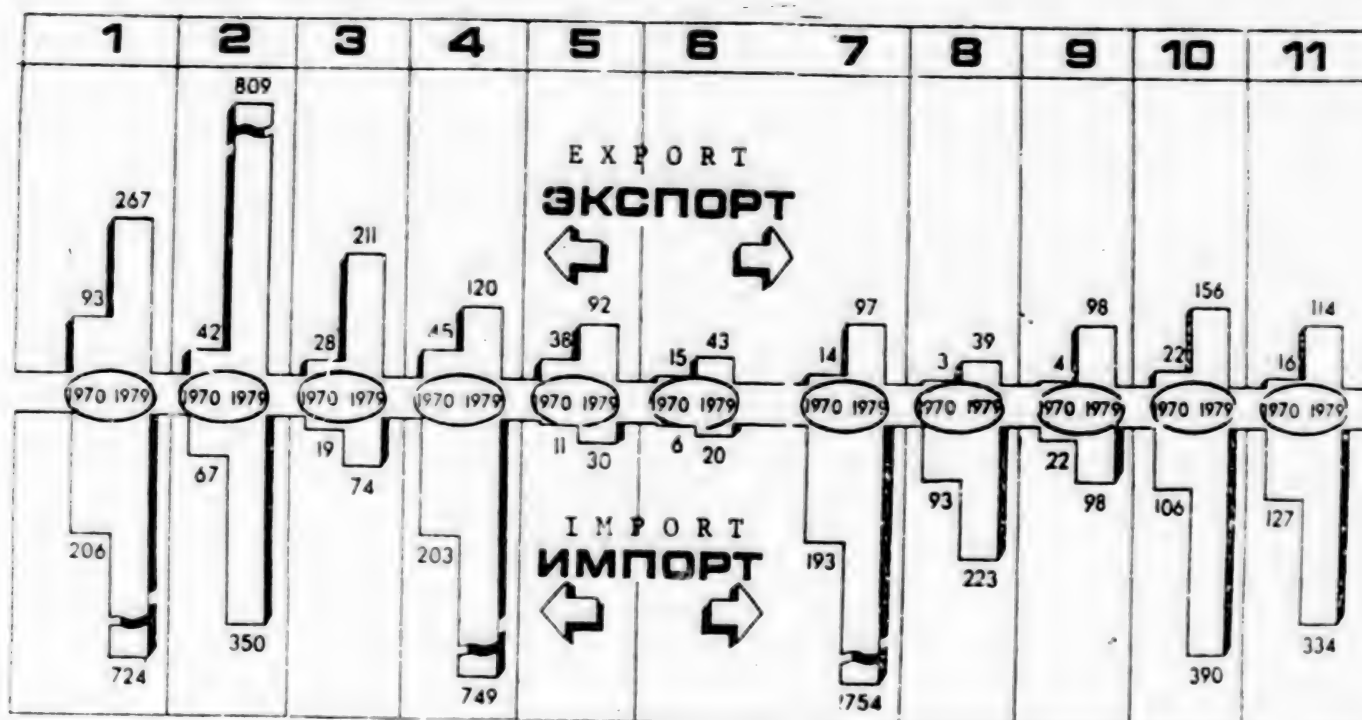


Statistical illustration. Geographical distribution of Soviet exports and imports by country in 1979 in millions of rubles. NOTE: Only those countries included with export (import) volumes of at least 10 million rubles. a - Poland; b - Rumania; c - Czechoslovakia; d - Bulgaria; e - GDR; f - Hungary; g - metal-cutting machines and forging and pressing equipment; h - GDR; i - FRG; j - Czechoslovakia; k - Poland; l - Switzerland; m - Japan; n - Italy; o - Austria; p - Bulgaria; q - Yugoslavia; r - Rumania; s - France; t - Great Britain; u - PRC. BOTTOM: A - Bulgaria; B - Iraq; C - Mongolia; D - Iran; E - Hungary; F - GDR; G - Yugoslavia; H - Cuba; I - Poland; J - Rumania; K - Vietnam; L - Finland; M - energy equipment; Q - Czechoslovakia; R - Poland; S - GDR; T - Hungary; U - US.



Statistical illustration. Geographical distribution of Soviet exports and imports by country in 1979 in millions of rubles. NOTE: Only those countries included with exports (imports) of at least 10 million rubles. a - Mongolia; b - Poland; c - Vietnam; d - Czechoslovakia; e - Rumania; f - Iran; g - Bulgaria; h - equipment for underground and open-cut mineral extraction; i - GDR; j - FRG; l - US; m - chemical industry equipment; France; n - Japan; o - Italy; p - Great Britain; q - Czechoslovakia; r - Hungary; s - Spain.





Statistical illustration. LEFT 1-6: Soviet export and import of equipment, rolling-contact bearings and tools in millions of rubles; 1 - forging and pressing and metal-cutting machines; 2 - power equipment; 3 - equipment for underground and open-cut mineral extraction; 4 - underground transport equipment; 5 - rolling-contact bearings; 6 - tools. RIGHT 7-11: Soviet export and import of equipment for various branches of industry in millions of rubles; 7 - for the chemical industry; 8 - for the timber, pulp and paper and wood-processing industries; 9 - for the construction materials industry; 10 - for the textile industry; 11 - for the food industry.

/The next problem involves not so much the technical level, but rather the economic rationality of the machine structure./ It is generally known that present-day machine building, both mass-scale and small-scale, involves a very high proportion of cutting and threading operations. Most of these operations in no way require the use of complex and costly screw-cutting and turret lathes. They can be successfully performed on simple and substantially less costly cutting and threading machines. In the meantime, for every 100 turning and turret lathes, the USSR has 7.2 cutting machines and 5.2 threading machines, 36.9 and 10.3 respectively the figures for the US, that is, 5 and 2 times greater.

Considering the key position of the machine-tool industry, what are therefore required are adequate investment and creation of capacities for production of the

special-purpose machine tools in extremely short supply for experimental and test work on the development of new equipment. We obviously, of course, cannot overburden the fairly limited capacities of this type with the fabrication of by-products. Krasnyy proletariy, for example, is making 30,000 roller mowers, which could be made by less specialized enterprises. This constitutes some 30 per cent of the work load of the special-purpose machine shop. The Moscow Machine-Tool Plant imeni S. Ordzhonikidze is employing its facilities to manufacture 7x14 m press molds for housing-construction combines.

It is also very important that we achieve a sharp improvement in the technical level and quality of machine-tool production itself. Domestic machine-tool purchasers and representatives of export organizations are pointing to the serious lag behind the best analogues (and this is evident from the material included in the selection).

The article by VAZ officials contains convincing figures on the comparative efficiency of the conventional domestically produced machines, the same machines manufactured in accordance with general VAZ technical specifications and analogous imported machines. As can be seen, an orientation on the VAZ specifications made it possible for some plants to increase machine quality sharply, while at the same time reducing the number of breakdowns 3-14-fold. But even these improved figures remain substantially below those for equipment bought in 1970-1971.

/Eliminating the substantial lag in our tool-manufacturing industry constitutes a very important condition of efficient machine-tool operation./ Production of tools and production components for metalworking equipment lags substantially behind present-day requirements and the possibilities of technical progress with respect to technical level, qualitative scales of output and level of organization as well as behind the requirements of the machine-building industry.

Structure of US Machine-Tool Industry  
(based upon 1977 data)

	number of enter- prises	number of workers, thous.	nominal net pro- duction	real- ized value	capital investment
				million dollars	
Production of metal-cutting machines	909	37.6	1093	2879	80.7
Production of forging and pressing equipment	425	16.1	723	1134	24.6
Output of production component	7154	85.6	2791	3910	176.9
Tool production	1408	39.7	1583	2372	77.6
Total by category	9896	179.0	6190	10295	359.8

Modern-day machine building ha  
components grow enormously. 1.

the role of the tool and associated production  
anced machine tools, particularly those with NPC,



and production lines, the machine, the tool and all associated production components are integrated. The productive efficiency of a machine tool will vary over a very wide range depending upon the tool and attachments with which it is equipped and upon their quality. The tool and associated components fairly frequently limit the efficiency of machine operation. As A. P. Kirilenko declared at the conference of machine-tool builders in March 1980, "the tool problem has become a particularly pressing one over the past few years."

While production of diamond tools has grown substantially, they are not yet of high enough quality, which remains below the world level. Hard-alloy tools, now employed most extensively in metalworking operations in the machine-building industry, are now manufactured here from billets which are substantially inferior in quality to foreign analogues. There is as yet virtually no production of the high-speed cutting tool coated with the nitride and other compounds of titanium which our industry has already tested.

/The organizational aspect plays an important role as well. Despite a multitude of decisions, we are still seeing no specialized production of ancillary production components, while the construction of new facilities is proceeding at an unwarrantedly slow pace./ These components are now being produced primarily by each machine-building plant "for itself," on something of the order of a subsistence economy. As stated in the article by D. I. Semenchenko, deputy director of the All-Union Scientific Institute for Tool Research, the result of this situation is that only one-third of our tools are being fabricated in specialized facilities. The experience of the American machine-tool industry is worthy of attention in this regard.

Characteristic here is the fact that enterprises of specialized branches manufacturing tools and equipment turn out almost 80-90 per cent of these products. The "coefficient of inclusion" [koeffitsient okhvata], as it is referred to in US statistics, has been 92 per cent in machine-tool production, 87 in forging and pressing machine production, 79 in the fabrication of ancillary production components and 89 per cent in tool production.

It is of particular importance to point out that with respect to nominal net production, the manufacture of ancillary production components exceeds by 2.2 times, and to value of realized production comprises 95 per cent of the production of the machine-tool manufacturing industry and of pressing and forging operations in machine building. In terms of volume of capital investment it exceeds these categories 1.7 times. With respect to nominal net production, tool manufacturing also exceeds machine-tool building and is almost equal to it in terms of volume of capital investment (96 per cent).

In the US, a large number of small enterprises are engaged in the production of tools and particularly of the components associated with them in the production process. The average number of workers involved in tool production here is 28, 12 in the manufacture of associated components (7154 enterprises). It should, it is true, be mentioned as well that small enterprises dominate the machine-tool manufacturing industry itself (41 the average number of personnel). There are two reasons for this. First, the predominance of medium- and small-scale production of machines, which in a number of instances are fabricated in accordance with specific customer requirements. Second, the existence of an extensive network of small enterprises manufacturing parts and functional components for these machines. It is particularly important to point

out that labor productivity in these small facilities, computed in terms of nominal net production per worker per year, is not only not lower, but even higher than in the machine-tool manufacturing industry itself: machine production - 29,100 dollars, forging and pressing equipment - 44,900 dollars, associated production components - 32,700 dollars and tool production - 39,900 dollars. These small plants are clearly quite efficient. It follows from what we have said that we need to create new capacities, accelerate the development of highly specialized tool-production operations and essentially reorganize a specialized industry for the production of associated production components.

As experience has shown, small, highly specialized plants in small towns may be extensively employed for this purpose. We might apparently find it worth considering as an advantageous transition to set up an intraministerial, and possibly a regional, specialization in tool shops of machine-building plants, each concentrating on certain kinds of tools and equipment and oriented on the requirements of the ministry or region as a whole. This experience has been most efficiently utilized by the Ministry of Tractor and Agricultural Machine Building and Leningrad machine builders. It needs to be exploited extensively.

We should solve problems associated with development of a broad base of enterprises specializing in the production of functional machine-tool parts and units on the very same basis.

The need for substantial modification of proportions in and accelerated development of the tool-manufacturing industry and industry engaged in production of associated production components and an intensified drive for specialization, particularly functional specialization, in the machine-tool industry itself is clear enough. In our view, this is the course we should pursue in allocating capital investments over the course of the Eleventh Five-year Plan.

The CPSU Central Committee, the USSR Council of Ministers and the 26th Party Congress have set the machine-tool industry some very important tasks. At the conference of machine-tool builders the Central Committee assigned the task of executing a revolutionary turn in the direction of improving the structural design of our equipment, raising its technical level and then on this basis of moving on a broad front with introduction into the machine-building industry of advanced technologies and highly efficient methods of production organization.

Pursuit of this course means a shift in the direction of intensive development of the machine. The Eleventh Five-Year Plan already calls for substantial reductions in the absolute number of machine-tools to be manufactured (at the expense of the outdated general-purpose models used as replacements in the subsistence operations in all branches of the economy) and significant improvement in their technical level and quality. Gosplan is proceeding on the basis of the need in this instance to increase the productivity of the new machines 1.5-fold over that of those they are replacing.

I. N. Snovskiy, chief of Gosplan USSR's machine-tool manufacturing department, points to the need to accelerate inventory replacement from the 2-2.5 per cent in the Tenth Five-Year Plan period to 4 per cent in the Eleventh Five-Year Plan. But with a 10-15 per cent cutback in production, how are we to double the rate of replacement of an enormous inventory like the one in our machine-building industry? Does that mean two-thirds of our output is going to have to go for replacement!? Will the remaining

third be enough for the accomplishment of all our other tasks? It clearly seems that we should outline an objective-oriented program of freeing up the numerous new machines from the "third machine-building industry" (the machine shops of nonmachine-building plants), particularly considering the fact that, as statistics demonstrate, the average age of the machines here is lower than that of machines in machine-building plants. There are no few highly complex problems involved here!

During the Eleventh and Twelfth Five-Year Plans we should set our course in the primary direction of increasing our production of machine tools with NPC, particularly of multi-operation working centers and of machine with NPC operating systems and built-in microcomputers. By way of implementation of the directives of the 26th Party Congress we are seeing the use of readjustable production equipment and components, to include working centers and unit machines with replaceable multispindle boxes. This will make production operations more flexible and mobile.

A highly progressive technical-organizational measure has been our work on the design and on organizing the production on an extensive cooperative basis of a unified series of drilling, milling and boring machines with NPC, which are being built on the basis of the modular-unit principle. Output of these machines will reach several thousand units by 1985, more than half of these of the "working center" type, which automatically changes tool and replaces billets. We must also achieve substantial increases in the scales of our manufacture of machines for finishing, to include superfinishing, operations. It would at the same time be to advantage to make more extensive use of the simpler and less costly cutting and threading machines to perform simple operations rather than employing our general-purpose machines.

We need to increase our billet production capacities taking into account the requirement of the major machine-building centers, including those operating on an interdepartmental basis. Any anticipated growth in machine-tool manufacture, and hence in machine building overall, is inconceivable without a sharp and immediate reorientation of the electrical equipment, electronics and instrument-manufacturing industries toward the requirements of the machine-tool industry.

/Just as the machine-building industry must unconditionally take into account the needs of the machine-using branches by everywhere setting up "machine service" operations, helping with the installation and assimilation of the equipment it has manufactured and by providing guaranteed maintenance and repairs, so must the machine-tool industry as well organize a full-fledged machine-tool service operation./ Much has properly been said about this in the articles which have been published, very interestingly and instructively in the article by VAZ officials. They point with equal justification to the absence of the economic conditions for the functioning of a machine-tool service operation. This problem has been characterized in very clear-cut terms by V. P. Kabaidze, general director of the Ivanovskoye machine-tool manufacturing association. It is clear that Gosplan SSSR, Goskomtrud [State Committee of the USSR Council of Ministers on Labor and Wages] and Minfin [USSR Ministry of Finance] must finally resolve this problem.

There is one other difficult problem involving the mutual relationship between our machine-tool makers and "machine-tool users," a problem of very great national economic importance. This is the problem of the dimensional parameters of our machines and of the pieces to be worked on them. As practical experience has demonstrated,



we have a substantial excess of machine capacity parameters, primarily, of course, in our general-purpose machines. A. Ye. Prokopovich, deputy minister of the machine-tool and tool-manufacturing industry, acknowledged this in pointing out that "every enterprise is trying to buy itself a machine 'one size larger'." V. I. Aksenov, a representative of the Tekhnika association, has told how pieces the size of a fist are being worked on 24-ton machines. "Everybody's trying to get a machine that's a little bit bigger," says L. N. Snovskiy, chief of Gosplan SSSR's machine-tool department. If you take into account the fact that in our experience there are almost no instances in which one plant has asked another to work a large piece (when the neighbor might have large machines not operating at full load), the situation becomes even worse. And then since any rise in fixed capital cost is of no particular concern to our plants, there are no, or virtually no, economic obstacles to the acquisition of excess capacities, particularly considering the fact that increased capital expenditures for the purchase of heavier and larger-capacity equipment are included in production costs.

This situation obviously requires impartial study; we need to "put our fingers into these sores" and see how many cannons we have firing at sparrows, to consider how much unnecessary metal these "cannon" are consuming and to draw the appropriate conclusions. A necessary condition, of course, is to insure high quality in the production of small machine tools so as to make it advantageous to buy them.

The problem of excess capacities also finds expression in the load imposed upon our most advanced and expensive machines. As was reported in the course of the roundtable discussion, our machine tools with NPC are in use as many as 230-260 hours each month, that is, they are working a little more than one shift.

A rational solution of this group of problems would to a certain extent relieve the machine-tool industry of an unwarranted share of this load.

Mobilization of the as yet untapped potential of our machine-tool industry, consistent pursuit of an expedient technical and structural design policy and utilization of the great store of experience at the disposal of the cadres of specialists and workers in the machine-tool industry--all these things will create the necessary preconditions for accomplishment of the large-scale tasks which the 26th CPSU Congress has set the machine-building industry and its key branch--machine-tool manufacturing.

#### FOOTNOTES

1. PRAVDA, 12 March 1980.

2. That is, no "excess" reliability, a situation in which individual components have reliabilities exceeding those of the basic units of the machine.

3. SOURCE: Izdatel'stvo "Nauka", "Ekonomika i organizatsiya promyshlennogo proizvodstva", 1982

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## METALWORKING EQUIPMENT

### ROUNDTABLE DISCUSSION ON COMPATIBILITY AND TECHNICAL LEVEL OF MACHINE TOOL BUILDING EQUIPMENT

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 1, Jan 82 (signed to press 14 Dec 81) pp 47-86

[Article by Ye. Lysaya and I. Ognov]

[Text] The editorial board of EKO [EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA] conducted a roundtable on the compatibility and technical level of machine tool building equipment at the Ivanovo Machine Tool Building Association where these problems are concentrated and are being thoroughly resolved. The management of the USSR Ministry of Machine Tool Building and the directors and leading specialists of enterprises and scientific research institutes of Minstankoprom [Ministry of Machine Tool and Tool Building Industry], Minelektrotekhprom [Ministry of the Electrical Equipment Industry], Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] and institutes of the USSR Academy of Sciences participated in the meeting. The editor-in-chief of the journal Academician A. G. Aganbegyan moderated the discussion.

A. G. Aganbegyan: The key problem for our country today is how to convert from the primarily extensive factors of developing the national economy to primarily intensive factors. The basis of this readjustment is scientific and technical progress proceeding to a significant degree via machines and equipment. What they are are the techniques and expenditures of capital, fuel-energy and labor resources.

In the "Basic Directions for Economic and Social Development of the USSR for the Period 1981-1985 and for the Period up to 1990," adopted by the 26th Party Congress, the prospects of machine building are considered in more detail than in all other sectors. They are faced with specific important tasks. The CPSU Central Committee and the USSR Council of Ministers have recently made a number of important decisions on readjustment of machine building. Machine tool building is the heart of machine building. I would like to look at the prospects for its development from broad national economic positions: the extent to which machine tool building products meet the current needs of machine building, what must be done for them to achieve a worldwide level and to what should public attention be attracted.

Customers: "Perhaps They Can be Fewer But Better"

S. A. Kheyman, Doctor of Economic Sciences, Professor and sector head of Institute of Economics, USSR Academy of Sciences, Moscow, says:

I would like to talk about some national economic problems related to machine tool building and about the background on which the problems of increasing the technical level and competitiveness of metalworking equipment will be solved. We in machine building use a few more machine tools than outside it. Forty-four percent of the metalworking equipment is outside machine building. But this equipment is also acquired there for other than collection. The inadequate reliability of production equipment and the absence of spare parts and warranty servicing force customers to create a giant stock of machine tools. And this stock must also be supplemented and restored. The respected director of the Ivanovo Association, whose guest we are, complained that he is being forced into the plan not only those excellent multitool machine tools which we saw on the assembly stands and by which the plant emerged to the worldwide level, but also simple general-purpose machine tools. This is easily explainable: machine building needs them in order to supplement and restore its own stock.

Our machine building and machine tool building are being developed to a considerable degree by the extensive route. During the past 16 years the United States has reduced the stock of machine tools and forge-press machines by 7 percent and we have increased them more than 2.5-fold, and we have increased them 2.4-fold in machine building and 2.7-fold in other sectors. How can there not be a shortage of machine tool operators?

This is one problem. If this stock continues to grow, all plants capable of building decent machine tools will be forced to pursue ordinary products. This "black hole" swallows everything and there is no time to produce high-quality equipment.

The second question is that the proposition on orientation toward the customer was formulated at the 25th Party Congress and it was intensified even more at the 26th CPSU Congress. How will machine tool building maintain this principle? What are the size parameters of machine tools and parts so as to work on them? Do the trends conform or not conform and which direction is the dynamics going in? Unfortunately, we are not making this analysis in the country.

V. A. Kudinov, Doctor of Technical Sciences, deputy director for scientific work, Experimental Scientific Research Institute of Metalworking Tools (ENIIMS), Moscow, says:

You are incorrect. There is a clear series of machine tool parameters confirmed by the GOST [State Standard]. I feel that everything is clear here. What machine tools should we make more of? That is the question.

S. A. Kheyman: True, true. There is a GOST network but how is it being filled? So far as I know, the gap between the dimensions of parts which are not being increased too much is becoming greater and greater and in many cases

are being reduced, as are the parameters of machine tools. This nonconformity is very expensive to the national economy.

A. Ye. Prokopovich, Deputy Minister of Machine Tool Building of the USSR, Moscow, says:

I also feel it debatable that the thesis that machine tool builders are not oriented toward customers by the dimensional groups of machines and are trying to produce heavy equipment. The volume of production of the Central Volga Machine Tool Building plants and some others than manufacture small machine tools exceeds the volume of consumption by approximately 20 percent. But the Ryazan' and Krasnyy Proletariy Machine-Tool Building Plants, which produce more heavy equipment, can meet their orders by only 25 percent. This is also explained by the fact that each enterprise attempts to buy "a larger machine for itself, by the higher quality of equipment of the Moscow and Ryazan' workers at comparatively low prices and by a number of other factors. We have sufficiently good analysis of the dimensions of equipment in traditional machine tools and we see the nonconformity between the parts to be machined and the overall dimensions of machine tools. A more serious question includes the fact that machine tool builders lag considerably behind in development of small highly productive equipment for instrument building and electronics.

V. I. Aksenov, chief designer, Scientific Production Association Tekhnika, Vladimir, says:

Semen Aronovich Khaynman correctly raised problems of size parameters. We have no quarrel with this. Everything that he says is valid in order to ascertain whether it is sufficient to visit instrument building or assembly plants. One can see how parts 100-200 millimeters in length and width are machined on machine tools with ChPU [Numerical program control] weighing more than 20 tons and costing 600,000 rubles. And this is done because there is no small precision equipment, especially of machining centers. As the specific weight of instruments used in aviation and space technology and the automotive industry increases and as lasers and other directions of scientific and technical progress develop, the need for this equipment will increase and will grow even more rapidly.

The most acute situation has also developed in providing machine building with small precision lathes both with manual and program control. Can one be surprised that some machine building sectors have taken on through their own efforts the manufacture of general-purpose small precision machine tools and that the difficulties in obtaining the sets of equipment for this have forced them to master the production of electrical equipment, sensors, measuring systems and even programming devices.

I do not think we have assembled at a roundtable in order to praise each other. This can be done at other tables. So then everything is not good with the structure of stock of metalworking equipment. And attention should be turned toward this.

Remark: We have on the average a heavier stock than in other countries. We love heavy machine tools.



V. A. Kudinov: I would like to refine this. Our stock is more stable and equipped with heavy machines, while the machine building products are evolving so that the parts are becoming ever smaller. Is this not so?

S. A. Kheyman: That's true! This means that the structure of the stock should change according to changing conditions! We cannot expand as many resources needlessly. The problem of the growing nonconformity between that which we machine and the parameters of equipment is very important in my view.

Soviet machine tool building is the world's largest scale and the plants are the largest. The worldwide trend is to produce machine tools of medium and small series. With mass production, machine tool building is taken away from customers who must then adapt their equipment to that which they have acquired.

The third problem is how do we raise questions I would say of the functional specialization of machine tool building? Many fight for specialization and I am among that number. I am sometimes asked "Why are you such a proponent of it? Foreign companies themselves are able to make machine tools for themselves but are our associations really unable to?" But the opponents forget one thing: the Ford Company, for example, actually makes machine tools for itself but they configure them by 90 percent--they buy finished functional assemblies and combine them as required. Is there a base in our machine tool building for producing functional assemblies? Almost none. A number of assemblies should be manufactured on the functional specialization principle. This would be significant progress.

There is yet another problem. It is clear that equipment can be renovated with such a gigantic stock of machine tools only by fundamentally replacing it. Approximately 30 years are required in order to replace it. The equipment customers are now conducting a modernization. I feel that the time has come to raise the question of so-called genetic modernization--the designers themselves should prepare the machine tool for future renovation.

A. Ye. Prokopovich: I feel that this is debatable. It is not feasible to carry out modernization of equipment with regard to our many years of experience without adequate engineering and economic foundations. Therefore, we set ourselves a task of increasing the durability and reliability of machine tools prior to the period of obsolescence and physical wear, we attempt to exclude major overhaul and to restore the stock more efficiently than is done in the entire world. The annual renovation of the stock of metalworking equipment is now at the level of 2.7 percent in the Soviet Union, approximately 5.5-6 percent in the United States and approximately 8-9 percent in West Germany. The stock in Japan is being renovated in approximately the same range and perhaps at higher tempos than in West Germany. The active part of the stock should be renovated. This is valid. The attempt to reface and modernize makes no sense except for those cases when a machine tool must be adapted for some special purposes.

S. A. Kheyman: Speaking of genetic modernization, I do not mean that the manufacturer will accomplish it for all machine tools produced. We are talking about the fact that designers should include in the machine tool design

the readiness for modernization so that the components of new models can be combined with the old base in order that this be a continuous process.

Question: But are heavy machine tools also not worth modernizing?

A. Ye. Prokopovich: No, heavy, unique machine tools are undoubtedly a different matter. The period for restoring them is somewhat different--20-30 years.

N. Ya. Samsonov, director of the Ivanovo Carding Machine Plant, says:

When are we customers going to appeal to the machine tool builders? Of course, when we must raise the level of technology, labor productivity and product quality. During the 10th Five-Year Plan, our plant had to double the productivity of our machines. The question was will the textile workers take them or not. The fact that they had manufactured them previously was to no avail. Life forced us to replace the machine tool stock. We appealed to Minstankoprom. We received machine tools with ChPU. We now have 60 of them and they are operating in two shifts. The operators, adjusters and technicians were trained. The Ivanovo Machine Tool Plant helped to master machine tools with ChPU. Of course, we are concerned by the absence of spare parts: ball units and others.

The situation is much more complicated with special machine tools. I am talking about my own enterprise and the plants of our All-Union Industrial Association Minlegpishchebytmash. Automatic production lines three times more precise than previously were required during the past five-year plan. They refused us, citing the fact that VAZ [Volga Automotive Plant] and KamAZ [Kama Automotive Plant] were producing them. We had to resort to imports. We purchased 60 production lines in Switzerland. But there are those which we have been ordering from Minstankoprom for 30 years and we still cannot obtain them. As a result we make mass parts ourselves on general-purpose machine tools as we did three decades ago. In the most complex situations when different solutions are required, we order the equipment from abroad and leave our currency on the foreign market.

Question: What part of the problems have you solved by using Soviet machine tools and what part are using imported machine tools?

N. Ya. Samsonov: We have purchased 15 million rubles' worth of equipment in foreign countries and approximately just as much in the Soviet Union and CEMA countries.

E. V. Kasimov, chief of engineering section, Stankoimport, USSR Ministry of Foreign Trade, Moscow, says:

We are a unique customer: we do not consume ourselves but purchase in other countries. And the requirements there are very different. Therefore, we are proponents that equipment be made--any kind--both ultramodern and simple.

But we also purchase metalworking equipment from foreign companies and we purchase approximately three times more than we sell. With regard to

Avtopromimport, the volume of purchases is even greater and it will increase all the time both in the total sum and in natural indicators. Exports will also increase but not as much as we would like. The reasons are in two categories. The subjective category is related to our own agency--we must learn to trade better and the objective reasons are many--they are related to the manufacturing plants and their partners in providing the complete set.

V. P. Kabaidze, general director of the Machine Tool Building Association, Ivanovo, says:

Yes, the volume of imports is high and it must be reduced. In this regard I would like to call attention to the one-way approach in evaluating the competitiveness of equipment. Only that which the enterprise has sent to the foreign market is noted. But no less important is the fact that it enters into competition with foreign companies on the internal market. By acquiring competitive equipment at our enterprises, our customers spend less currency on imported purchases and this yields an enormous saving. Unfortunately, this aspect of competitiveness is not taken into account. Only exports are considered. We know this from our own experience. They talk approvingly about the fact that the machining centers of our plant make purchases in economically developed countries. But the fact that our customers refused to acquire or rather reduced purchases of similar products abroad is not taken into account when evaluating competitiveness.

E. V. Kasimov: Speaking about the competitiveness of machine tool building, it should be determined what is good and what is bad. Apparently a piece of equipment which is exhibited at specialized international exhibitions can be taken as a model. I shall present two exhibitions as an example: 1979 in Italy and 1980 in Japan.

The exhibition in Italy emphasized progress in ChPU systems for all types of equipment, while the broadest miniaturization of components led to the fact that systems do not stand separately today but are built into machine tools. The operator can work with the machine in the dialogue mode. Machine tool designs have not undergone fundamental changes. Maximum attention is devoted to automation of equipment and to its simplification and increase of reliability.

DC motors occupied the prominent position in electric drives but AC motors with so-called deep regulation have begun to appear. One can say that we also have them. But not yet in developments.

Western companies devote attention to measuring devices. These devices have a great future. They either exist separately or they are built into machine tools and correct cutting conditions during machining of parts. We were convinced that they are used here when visiting the shops of the Ivanovo Machine Tool Plant.

The machine tool building industry in Japan, as is known, occupies third place in the world in volume. It is typical that it exports half its products. Japan began to purchase licenses in the 1960s, but now sells its original designs.

What is the fraction of machine tools with ChPU in Japanese machine tool building and what is the future of them? They comprise 41 percent of the total volume of output in cost. The Japanese have taken the path of producing general-purpose machine tools with ChPU, whereas Europe and America develop more special equipment.

Scientific research is very developed in Japan. There are coordinating centers. Specific individual developments are attached to companies. Their periods are exceptionally short. The Mitsubishi Company develops a set of documentation in three months and manufacture of a new machine requires 8-9 months. One can cite the example of how the Japanese delivered to Atomash the world's largest double-action hydraulic press with force of 15,000 tons. The entire process, including signing of the contract, required a little more than 1.5 years.

The composition of workers of Japanese machine tool building companies is interesting--half and some places even more are engineers. True, before entering the engineering service should spend approximately 5 years directly in production.

A total of 67 Japanese companies was occupied as machining centers (OTs). In 1979 they produced two tons more equipment of this class than the United States. The functions of tool holder and manipulator are combined in most Japanese machining centers. This is also true at the machining center of the Ivanovo plant. Exactly like satellite benches, while a part is being machined on one a new one is being prepared on another.

Now a few words about increasing the competitiveness of our equipment. All foreign purchasers have general requirements, fulfillment of which is necessary to increase exports. What are these requirements? High productivity and compactness, lower energy consumption, reliability and safe and convenient servicing of machine tools.

The requirements on maintaining the accuracy of equipment during operation and on the quality of manufacture and on expansion of the production range were increased. Our customers bring attention to equipping them with accessories, the capability of using modern cutting tools and materials on the acquired machine tools and on the conditions for maximum reduction of auxiliary time. Great significance is given to reducing the periods of delivery and to improvement of servicing and support with spare parts.

A few words about the Ivanovo workers. We can take off our hats to them. They have wrought a miracle within the shortest deadline: they have intensified the production of such complex equipment as multitool machines with ChPU of the "machining center" type. But how many Ivanovo machine tools have been sold on the foreign market? Only 10! Contracts have been signed for five more. And beyond that no negotiations are heard. I do not wish to say that this is the fault of the plant. It is trying to do everything in order to trade in machining centers. But it has many problems with making up a complete set. The cost of the machine tool is high.



I. M. Volkovskiy, candidate of technical sciences, deputy director of the Scientific Research Institute of the Elektromashina Association, Prokop'yevsk, says:

Some call the scientific research institutes and design offices criminal as if they are guilty of raising prices. On one hand, this is not quite correct. On the other hand, both we and the customers are proceeding consciously toward this. After all, a plant is interested in assimilating a new machine that requires high expenditures only if its efforts are compensated. Otherwise it and the scientific research institute and design office will not negotiate. The customers also know this.

V. M. Kozin, candidate of technical sciences, deputy director of the Scientific Research Institute of Unit Electric Drives of the Elektroagregat Association, Novosibirsk, says:

We are not in any case interested in raising the price for a new article. After all, the higher the price the lower the saving and the lower the deductions to our incentives funds. Therefore, the institute is attempting to squeeze the price to the limit and to vindicate the manufacturing plant. The functional-cost analysis (FSA) method helps us to justify the price. By using it, we have analyzed all new articles and have found a method of how to reduce the cost of many.

V. I. Aksenov: And still, Vladimir Mitrofanovich, the prices for machine tools and for the components for them will increase. When we concluded an agreement with your institute for the Razmer-4M ChPU systems, we agreed that the first production in the unit would cost 70,000 rubles per unit. In fact it cost 120,000 rubles. The price was then lowered to 98,000 rubles but by 1981 had again jumped to 108,000 rubles.

E. V. Kasimov: The price for machine tools with ChPU is dropping all the time on the foreign market because electronics and control systems are becoming less expensive. This must be taken into account. And one other important factor of competitiveness about which I would like to talk is outfitting the equipment.

Some models of the Krasnyy proletariy machine tools and those of the Krasnodar, Yeysk, Molodechno, Melitopol' and some other plants are competitive on the foreign market. However, there is still one complaint against the exported equipment. It is inferior to foreign counterparts in the makeup of accessories and tools, which considerably reduces the production capabilities of the machine.

For example, the automatic lathes of the Tornos and Traub companies are made up with approximately 40 types of different accessories, while a similar machine tool of the Melitopol' plant has only 17. The agent companies selling Soviet machine tools abroad are forced to outfit them with purchased accessories of foreign manufacture.

## Machine Tool Builders: "Break the Economic Binds"

O. A. Korolev, general director of the Krasnyy proletariy Machine Tool Building Association, Moscow, says:

Yes, we know that 30-50 percent of the capabilities of our equipment embodied in the design are not utilized due to the absence of high-quality tools. Upon order of Stankoimport we have equipped the vertical semiautomatic machine with tools of the Karomant Company, which increased its productivity by 30 percent. The problem of tooling is becoming very acute. But it must be solved by the machine tool builders themselves. And we do not have any free capacities or labor resources for this. And even materials, because hard alloys are not being allocated in the required volume to machine tool building for our own needs. And metal cutting equipment is being designed by the existing procedure for the customer's tool.

V. P. Kabaizde: We must organize production of tools for machining centers. It is complicated and precision work, an additional load and laborious. And there are no advantages at all. We are required to fulfill the plan for machine tools in units and this is what we receive a bonus for. Let us develop mobile production of new equipment. Is it advantageous? No! I will not say that we have lost many people and this has worried us. Of course some have left because there are no bonuses. Our engineers work because they are interested in seeing the results of their labor--man does not live by bread alone. Where is the designer who can see his machine tool within several months from the beginning of design? This possibility does exist in our association. Of course, the fellows lay it out and sometimes work without days off. However, such labor, besides moral satisfaction, should be materially rewarded. They now hardly praise us and they are hurt by this, but not one plant has followed our example. Our bonds are economic. If we do not break them we will never achieve great success.

O. A. Korolev: I feel that those problems which machine tool building faced during extensive development were solved. We have been called upon to increase production and we have developed those tempos and have solved those problems which never had any precedent in the world. The services of Soviet machine tool building is that it was concentrated and developed mass inexpensive production. Machine building was provided with metal working equipment.

Of course, it is not good if a poor machine tool is produced in a large series. But on the whole mass production is good. Our plant has managed to retain its low laboriousness and cost with sharp expansion of the nomenclature, improvement of quality, precision and reliability of equipment and to increase the utilization factor of metal due to the advantages of mass production, the initiator of which in machine tool building was the Krasnyy proletariy plant. The association fulfilled the task of the 10th Five-Year Plan in all engineering and economic indicators and produced 1,200 metal cutting tools, of which 300 had ChPU,\* above the plan.

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\* EKO reported about the experience of Krasnyy proletariy in No 1, 1978.

A number of new machine tools has been developed during the last few years, including facing lathes with ChPU for the aviation industry and machine tools of especially high precision for instrument building and laser technology. The specific weight of progressive types of equipment in the overall structure of production in 1980 increased 54 percent in the association compared to 14 percent in 1975. Our plant was the world's first to propose making machine tools with ChPU on an assembly line: after all, according to the decree of the CPSU Central Committee and USSR Council of Ministers of 18 February 1980, one-third of the production in the sector falls to us.

But scientific and technical progress and intensification of production require that the system of economic indicators of production and economic activity also be aimed toward achieving the final national economic effect. There are now 60 indicators at the plant, behind each of which is a collective and its welfare. If even one is not fulfilled, the engineering and technical personnel stop without progress and it is not excluded that some will leave for those places where bonuses are paid.

For example, we developed semiautomatic machines for machining the camshaft of KAMAZ trucks, which are three times more productive than similar machine tools produced earlier. However, the laboriousness of their manufacture is two times higher. We should undoubtedly take old models out of production. But after all in this case the plant may be under the threat of not fulfilling the plan in units for special machine tools. As a result, in order to make one good machine tool, we are beginning to reduce laboriousness by making some machines simpler.

We must cope with indicators, rejecting those which do not characterize the work of the sector and which did not aim toward the final results. Because until new equipment is profitable, the plant will produce "units." There will be many indicators and it must think about all of them at once. I feel that much must be done by economic science to determine the relationships between the final national economic results and specific indicators of enterprise activity.

V. P. Kabaidze: I do not wish to run down what has been done, but I must speak frankly today about the problems of metalworking equipment. Machine tool building is losing its positions won during the 1950s and 1960s due to the engineering level. The pattern has become more complicated. We are seeking new points of application for specific types of machines. But after all not only machining centers and machine tools with ChPU are necessary. But what about special machine tools and automatic lines for mass production? As my colleague and fellow townsman Nikolay Yakovlevich Samsonov so convincingly pointed out, even here there are problems similar to those due to which the level of machine tools with ChPU are lagging behind. And modern electric drive, ball screws and so on are required for this equipment.

I was in Finland in 1977. You know that its machine tool building is indiscernible on the worldwide background. There are no machine tool building plants there. There are shops attached to three companies. I had the occasion to visit one of these shops. Sad to say, it has only 75 persons. The



plant director escorted me and says: "I am also a machine tool builder of sorts." I thought: "What is he talking about!" But when I looked I was ashamed. They make the simplest machine tools, but they have ball screw and a high-torque motor. And it is inexpensive. On the one hand, primitive, and on the other inexpensive are excellent engineering solutions.

Poor machine tools put us 10-15 years behind. It is extremely important for the country to concentrate on this problem. Or we will never be able to transmit the alarming state which machine tool building arouses!

The misfortune is that no one is waiting for us. The world is moving very rapidly. Every year there is a new generation of electronics: now adaptive monitoring and other things. We must find methods for flexible production and of stimulating them economically.

G. A. Kulagin, senior scientific worker of the Financial and Economic Institute imeni N. A. Voznesenskiy, Leningrad, says:

Many problems which are raised here depend not only on enterprises but on solution of some problems of organizational and economic nature whose time has come in the national economy. On the whole our plants are too large and universal; therefore, they are not very flexible. If a plant has 10 or more types of products they cannot be equivalent in the existing system of indicators. One can extend a "shaft" or normative pure product, sale or some other indicator important to the enterprise. But there's not reason to beat it--you can suffer for it.

Just take the history with ball screws which machine builders need so acutely. The Odessa plant was entrusted with making them. But what if this were an independent plant making only screws and there was no one to make up for the underfulfillment? And what if the design office would only "sit" on screws and what if the mark and reputation of the plant depended only on screws? Really, there would be enough of this product for everyone. The Odessa workers are making screws, but not in the quantities as required because their main product is something else. Screw production has also been organized at Ryazan', also at a large machine tool building plant. And several other enterprises are involved in them, including the Leningrad Machine Tool Building Association. But what if there were a specialized firm? Obviously, one must proceed toward development of small specialized plants for which this product would be the only task.

A. Ye. Prokopovich: I would like to talk about the engineering level of machine tools in general, including those with ChPU. Only 10 percent of machine tools are protected by inventors certificates that ensure considerably higher indicators compared to the best foreign models. Their level is the world's highest. Stretching a point, we say that 90 percent is at the level. But this equipment requires significant improvement. According to calculations and the determined need, machining centers should comprise approximately 12-15 percent of the total number of machine tools with ChPU. This, incidentally, corresponds to the structure of the worldwide stock.

Efficient operation of machine tools with ChPU is closely related to this problem. It is useless to offer them in 1-3 and even 5 units. They pay for themselves when their minimum number is 15-20. Internal and engineering servicing are then profitable. And since we do this, giving one each machine tool or manipulator, we don't achieve anything except discrediting of an idea. Manipulators must be offered in combination with machining centers and other progressive equipment, then it has a technical and economic effect.

We machine builders are solving the following problems during the 11th Five-Year Plan: supporting the required rates of development of machine building designated by the 26th Party Congress by increasing the productivity of our equipment. It is suggested that the output of progressive equipment be increased 1.5-1.6-fold and that the number of machine tools be reduced by improving the structure of the stock. The problem is posed of increasing the reliability and durability of equipment by 30-40 percent of the level achieved.

At the same time our creative forces--design offices, scientific research institutes and scientific and engineering services of coexecutors--should work intensively toward the 12th Five-Year Plan. If we do not think now about new types of equipment, electric drives and ChPU systems, if we do not check them now, then we will not make the corresponding jump during the next five-year plan.

The aggregate of all the named factors will help us to find the optimum solution in increasing the technical level and competitiveness of machine tool building products, but only provided there is very active assistance of economic science. After all, new equipment cannot be made here in 10-15 years but we can fulfill the plan and enter the ranks of the Red Banner of Labor. The director has begun to become intensively involved in new products and the plan has been in last place for 3-4 years, but the management itself is being reproved. Therefore, I fully join in with the hot words and the great pain which the enterprise managers have expressed here. I am concerned with introduction of new equipment in the sector and should unfortunately say that new equipment contradicts the main economic indicators of the enterprise in the first phase of introduction.

A. G. Aganbegyan: And what must be done?

A. Ye. Prokopovich: A system which would stimulate and interest the enterprise collectives in producing new equipment. New articles are now being introduced in many cases in administrative procedure. Individual persons are receiving bonuses but the creative collectives are receiving awards to an inadequate degree from introduction of new equipment.

A. G. Aganbegyan: The decree of the CPSU Central Committee and USSR Council of Ministers adopted on 12 July 1979 is a significant step forward in improving the economic methods of management and it contains many valuable elements. With proper application it will better stimulate the output of new equipment. Conversion to a stable five-year plan will undoubtedly contribute to technical progress. Purposeful programs should also play their own role. The variation

of wholesale prices, which will be introduced in 1982, will have an effect. The principle dependence of price on the saving and sharing of this saving between the manufacturer and customer are being established. Finally, creation of a unified fund for development of science and technology, rather significant incentives awards for products of a high engineering level with the Emblem of Quality, awards for saving materials which the enterprise will feel in a number of years after the article is replaced by a more material-consuming article and so on have been provided. Of course, all these propositions must be implemented and without distortion.

The main condition is that there be a good, substantiated plan balanced in resources. And we do not know how to make good plans in some cases. And the misfortune of collectives who convert to assimilation of a new product begins with the fact that this conversion is not taken into account in the plan. The plant is left with everything that it did previously. If a good plan were made, then the Ivanovo comrades, for example, would not find themselves in a severe financial position. All this can be taken into account in planning.

#### "Soft Goods" and Rigid Conditions

A. G. Aganbegyan: There is still one problem about which we should talk today--maintenance of machine tools. It is felt both on the internal and foreign market. Many now know how to make decent equipment, but maintenance is something else, although the prestige of the plant mark depends on service.

G. A. Kulagin: I feel that in its time Minstankoprom was correct in its attempts to organize a maintenance center and installation organization at each plant. And this has been done at all proper firms. The idea of company service was later replaced with territorial centers as an abortive matter. This was agreed on immediately and even so multiple-user program preparation centers (KTsPP) appeared. As a result there were neither programs nor service!

No middleman should be placed between the producer and customer. Moreover, the machine tools of Ivanovo, Leningrad, Krasnyy proletariy and so on should not be serviced from one center. You recruit neither specialists nor spare parts and in the end there is no responsibility. The principle here is clear: each producer should take service and this "soft goods" on himself. They have now begun to pay for services and there is a gain from this and as I heard, this is even calculated in fulfillment of the plan for commercial products.

V. P. Kabaizze: But there is a shortage of trade-union members--no staff has been added! And you must always select who is to suffer: either the plan or the plant's reputation. The wage per worker at the enterprise is an average of 15,000 rubles annually but service hardly covers the travelling allowances. So let's recruit the most qualified specialists for service!

G. A. Kulagin: Well, even so, it's still advantageous. I do not know what conversion to net production will yield. According to the idea, it should smooth out differences. The economic conditions in which "soft goods" would be no less advantageous than manufacture of products should be legalized. I know that in some foreign companies this activity yields almost half their profits.

E. V. Kasimov: It goes without saying that nothing is free. I would like to note that the manufacturing plant will really have to become involved in maintenance when the customer has the right to select the product. The customer should have the right to select a product and it should not be distributed or thrust upon him as is done in our material and technical supply system. He should purchase machine tools from the Ivanovo or Tbilisi plant or even perhaps the Gidelseister Company at his discretion. Of course, serious rearrangement of the legal and economic base is required for this. It is complicated to provide the opportunity to select machine tools. But it is time to begin study of this problem.

O. A. Korolev: Until the director has a service staff and compulsory indicator and until there are calculations of service volume, he will not become involved in this and there can be no calls for it.

An attempt was undertaken during the 11th Five-Year Plan to reduce the output of machine tools in units at the expense of a progressive structural shift of machine tool building products. But again there is no servicing in the plans. That means it is difficult to expect improvement during the 11th Five-Year Plan. I particularly do not want to interfere in the affairs of Stankoimport. But there they require, one can say, free service. True, they pay small export bonuses. And when a person services machine tools abroad, he does not give any commodity here! Now, when a personnel limit will be confirmed to enterprises according to the decree on improvement of the economic mechanism, dated 12 July 1979, they will run like the devil from a grave from any "soft goods" and other work that does not provide a plan in units and in nomenclature.

G. A. Kulagin: It is obvious that Stankoimport must take part of the sins on itself. It also has a territorial approach to organization of service. You order a single specialist to service machine tools of different plants which were acquired, for example, by Europe. He knows his own machines, but he does not know those of other plants and in order not to lose his own prestige, he makes complaints about foreigners even when it is a trivial matter which the representative of the manufacturing plant could resolve in a minute locally.

Apparently even abroad manufacturers must be recruited to service their own customers. Why cannot the Leningrad Machine Tool Building Association imeni Ya. M. Sverdlov, which exports machine tools to many European countries, not have two-three specialists there? They could disassemble and service their own machines. I think that this service would greatly raise the reputation of our machine tools.

We sometimes suffer due to inflexibility. I recall how I visited a plant in Vienna once, where I happened to be immediately after the war. The director knows me even from those times. This plant now produces cranes and sells them in exchange for machine tools. I asked the director: "How are our machine tools?" "Not bad," he says, "you can work with them and they are powerful and functional. But if difficulties sometimes arise, I write to the middleman company, it writes to the trade organization and from there they write to Stankoimport and Stankoimport writes to the plant. About three months later



I receive an answer along this chain: 'This cannot be. You do not know how to handle it and so on.' I write a second time. After about three months they answer me that they are willing to correct any specific maladjustment. After a year a repairman comes and everything begins to operate."

"Does nothing like this really happen with the equipment of foreign companies? Any number! We call by telephone. An engineer arrives within three days and he has everything necessary in his luggage. And the firm's reputation is saved." The operational nature of servicing abroad is very important to increase the competitiveness of equipment. There is something here for Minstandprom and our foreign trade companies to think about.

A. Ye. Prokopovich: Comrade Kulagin is right. There are gaps in organization of service. The machine tools plants are trying to transfer this problem to collective-user centers which are not ready to solve it. Therefore, the sectors perhaps need a main center for servicing during the warranty period and after that it should be entrusted to the leading machine tool manufacturing plants. However, minor maintenance problems and engineering support will be performed by regional service centers--collective-use program preparation centers.

The Same for Earth as for Space!

A. G. Aganbegyan: The time has come to touch on one of the sorest points: making up a complete set for machine tools. Where shall we begin? With Minpribor?

N. A. Smirnov, chief designer of ChPU systems, Minpribor, says:

Since 1958 Minpribor has organized development and production of ChPU systems in a rather wide range and the number of devices produced in 1981 will exceed 40,000.

Due to the shortage of capacities in our sector, ChPU systems will begin to be produced at Minradioprom [Ministry of the Radio Industry], Minaviaprom [Ministry of the Aviation Industry] and other ministries using our technical documentation. We feel that by this we will be able to "comb out" an exceptionally wide nomenclature of production programming devices of different agencies.

Passions warmed around our articles, simple and complex and with built-in computers, because the time had come to convert from programming devices based on small- and medium-integrated circuits to those with broader capabilities, developed on the basis of microprocessors, large integrated circuits and microcomputers. Development of these devices has been completed and the adoption phase is underway.

Remark: Your systems are still insufficiently reliable.

N. A. Smirnov: According to our data, and we assemble accurate statistics, serially-produced systems do not appear too bad.

Question: And compared to foreign systems?

N. A. Smirnov: I would say that ours are not very well thought out. This is now generally a problem broader than the service problem. We are now solving the problem--we are replacing serially produced systems with more modern systems designed on a microprocessor component base.

V. I. Aksenov: Analysis of operational data of machine tools with ChPU shows that there are unfortunately many comments on reliability parameters. And this depends mainly on the component base. The noise protection is inadequate and sensitivity to overheating reduces the level of programming devices.

According to the data of plants having a large number of machine tools with ChPU in operation, the time losses to correct failures in electronic systems is the main cause of their idle time. Calculations have been made abroad which show that an hour of idle time of a modern high-precision machine tool of the "machining center" type costs 1,200 dollars. Hence, it is clear how important it is to increase the reliability of the electronic systems of machine tools.

V. A. Kudinov: Specialists of Minelektronprom [Ministry of the Electronics Industry] have now concluded that the reliability of systems with ChPU should be even higher than in precision machine building. The accuracy of the device, machine or other article depends on the machine tool on which the metal is machined. And what was the previous attitude toward ChPU machine tool systems? Think about it! They stop. They are idle almost as much as they operate.

N. A. Smirnov: They have ordinary capacitors and these are constant problems.

R. B. Margolit, chief of laboratory of Machine Tool Building Association, Ryazan':

Our plant produces various machine tools but equipment with ChPU determines its features. To say that it achieves the best worldwide models is to go against one's conscience. We have met frequently with representatives of Minpribor. I think that I can safely say they can recognize that they have not coped with ChPU systems.

First, it is expensive for the country to harbor principle illusions. If an erroneous decision is made, then all promises to change it take 5-10 years. Management of developments and the decision-making system are very inertial. And there are many errors here because Minpribor did not want to take development of systems into its own hands and to review what machine tools require. It waited and waited for the machine tool builders, without knowing the capabilities of mathematics and electronics, to clearly formulate these problems.

We are now making 99 percent of our lathes without feedback devices. They more or less provide accuracy during the first 3-4 months of operation but they are unable to maintain this principle over a period of years. But they continue to produce them.

N. A. Smirnov: They told us--stop asking the machine tool builders, they do not know the capabilities of computer technology, make the systems yourselves. But how can they make them without close contact with the customers? The simplest problem is to introduce adaptation conditions in accuracy and from the results of measuring machined parts. To do this, an agreement must be reached with the machine tool builders as to which data from the machine tool we will introduce into the system, which sensor will be used to make the measurements and how the results will be processed and the program corrected. The more complicated the problem, the closer the contacts with machine tool builders should be.

R. B. Margolit: The second cause known to both us and instrument builders is the absence of a suitable component base.

N. A. Smirnov: We understand that we cannot count on development of better models if we must wait for years until industry begins to produce the necessary components. But even so we are acting properly: to do this on the component base which has been authorized for a given type of product. Minpribor has many times raised the question to the corresponding organizations of supplying more modern components for ChPU systems. I recall only the ChPU system for Elektronika NTs-31 machine tools developed by Minelektronprom. You compare its component base and our systems and there is an enormous difference. There is a 16-fold level of internal storage integration and their internal storage components are four times higher than ours.

Question: Should Minpribor compete with Minelektronprom? Do you have these capabilities?

N. A. Smirnov: We are not talking about competition. The problem has been posed to us of providing machine tool building with modern ChPU systems. And we intend to cope with it with full responsibility. Yes, we will be inferior to the electronics workers in some aspects, but this is not the heart of the matter! The main thing is the composition of the control functions which is suggested to machine tool builders and by this indicator the Elektronika NTs-31 is no masterpiece.

I feel that the main problem today with respect to the component base is memory elements. They should store information in any situation: with cutoff of power supply, on weekends, during holidays and so on. A memory is used in the same NTs-31 which should be supplied with a storage battery if the power supply is cut off. But there are still no storage batteries with the required indicators. One can use components of the so-called burn-through memory for a specific part of the information. However, now with burn-through, up to two-thirds of each purchased lot goes to production waste.

Remark: And this is still good! It's this way with these components throughout the world. That is why they are unpromising.

N. A. Smirnov: But for the time being they are the only ones for us. All our hopes are related to conversion to components with electric recording and ultraviolet erasure. Pilot models have been produced, but deliveries of

serial articles are only beginning and their cost is above the permissible cost. We are delaying the conversion to these components and even so we are not reaching the worldwide level mainly due to the insufficient capacity of computer devices. We are forced to operate with microcomputers in which the speed is low even in the certificate--40,000 operations per second, but it is actually even lower. As a result, it is possible to realize only the main composition of control functions and we have not even reached the second problem--expensive monitoring of the machine tool efficiency. However, we are firmly convinced that we will solve these problems in the near future.

R. B. Margolit: It is difficult for me to share your optimism, Nikolay Alekseyevich. Yes, we have ascertained that there is a corresponding component base in the country--the ChPU device Elektronika NTs-31 has appeared which permits efficient use of program control under conditions of small-serial and even unit production.

Illusions are being built that the NTs-31 is an operational control device and the letter "O" has even been assigned to the designation of the machine tool. Only there is nothing of the kind there at all. Essentially, this is a traditional ChPU device, only with inconvenient entry of control programs. I feel that the developers of the NTs-31 have thoughtlessly repeated the research versions of the leading Western companies.

Machine tools with programming devices have not yet encompassed too broad an area: only medium-serial production. It is now the turn of machine tools, with which one can go on to larger series and can formulate equipment oriented toward non-human technology. This equipment should be joined to robots that provide kinematic crushing of chips, monitoring of machining accuracy, breaking of a tool and introduction of a reserve tool. I would like to emphasize that these requirements can be met not so much through design of machine tools as through the engineering capabilities of systems with ChPU.

N. A. Smirnov: Incidentally, Minpribor was third in cooperating in the development of the ChPU system Elektronika NTs-31. However, if one speaks honestly, the NTs-31 has not changed the parameters of the lathe: its precision and productivity remain the same.

I see the second danger in that engineering policy and ideology of control systems are arranged in different directions: a mass of standards is issued for the ChPU device and general standards are issued for machine tools in languages and for tying in systems. The Elektronika device does not correspond to many of these documents. However, the fact that a new direction with different organization of software is occurring with this ChPU system is very alarming. The forces of programmers are being dispersed, continuity in software for different models is being lost and the periods of development are being extended.

V. A. Kudinov: I do not quite agree that the Elektronika NTs-31 is poor as an operating system. Why does it still not meet all the requirements placed on these systems? We have no built-in operational device for control program preparation. If we had it, being given minimum input data, we would



immediately produce a parts machining program. But for the time being we enter the mass of production information--geometric parameters of the part, machining mode, correction, accuracy and tools--into a large computer. And this is not because there are no small ones. They can be assembled. There is no powerful software. We are encountering enormous difficulties in creating this "soft good." Enormous expenditures of the labor of highly qualified specialists are required and there are not enough of them. This is where the efforts of the sectors, both of ours, the aviation industry and others, should be combined.

Our institute was reprimanded for the fact that we could but did not develop a machine tool control system which would be better than any in the world. I assure you that absolutely nothing can be done immediately without working on the idea constantly, without realizing it in practice and without checking to see whether it is possible or not. This is the way it is with systems. The ideas which we are getting will remain just ideas. Checking and realization of them rely on old problems--there is no organization which can quickly implement an idea.

For example, it has long been known that the nomenclature of systems must be reduced and they must be made sufficiently flexible; on the one hand, they should be miniaturized and on the other they should have a unit structure. By configuring and changing these units, the systems could be built up. And service would be facilitated. The ideas have long been known and the structures have been drawn. But we and the electronics workers are just beginning to approach these problems. We are encountering the fact that the necessary component base and special developments in software do not exist.

This is a complex problem and agency dispersion interferes very much in completely solving it. Correlations and correspondence are beginning immediately but things will suffer from this. Why was it possible to develop the Elektronika NTS-31 within a short deadline? Because from the very beginning they did not work according to traditional rules but eliminated all the interagency red tape. The collectives of scientists and the Krasnyy proletariy plant cooperated in the closest manner.

Question: Even so, what will be in the future? Will Minpribor combine its developments with Minelektronprom?

N. A. Smirnov: I would like to emphasize again that Minpribor feels the interference of Minelektronprom in development of modern ChPU devices is beneficial. It is beneficial from the viewpoint that Minelektronprom has taken on itself development of the required standardized production equipment, on the basis of which ChPU systems of different configuration could be constructed. And there is enough work for everyone.

Our capacities will not stand idle. Production of manipulator robots and other types of automated equipment is being expanded. The need for ChPU devices will increase.

V. M. Kozin: It makes not sense today to divide things up like 10 years ago: the component base with Minelektronprom, the ChPU system with Minpribor and

the electric drive with Minelektrotekhprom. If this narrow specialization were somehow understandable and justified during the first phase of development of an essentially new direction of technology in the national economy, a new type of integration is now required. The development of technology has reached the level when interagency barriers must be removed and to do this, great flexibility must be given to management structures. Apparently one of the methods is specific interagency programs and perhaps associations. We are striving towards this, developing together with ENIIMS and the Zelenograd Scientific Center, a common system for multicoordinate machine tools and machining centers. But the barriers of agencies unfortunately are not always surmountable.

#### Time Passes and Problems Remain

V. A. Kudinov: Little is yet said about electrotechnical makeup units. And after all, they leave much to be desired.

V. I. Aksenov: Why, for example, has production of seven types of high-torque motors been developed at Minaviaprom? Because the electronics engineers do not make them at all.

I. M. Volkomirskiy: I have no quarrel, at one time we saw the moment without the assistance of Gosplan when production of DC machines would have to be developed. Capital investments in this subsector were delayed. It is not surprising that its capacities are in sharp contradiction to the country's needs.

O. S. Korolev: We are very concerned about the fact that we must use a large number of imported makeup units. If they break down for any reason at the customers, it will be difficult to do anything with the absence of spare parts and the currency is wasted. Therefore, we are against equipping serial machine tools with imported makeup units. I see real attempts to improve the support of machine tool builders on the part of Minelektronprom and Minpribor. But the position of Minelektrotekhprom simply worries us. There are so few high-torque motors, even now.

V. I. Aksenov: Can one recognize what is occurring with the quality of motors of the Prokop'yevsk Plant Elektromashina? It grows worse every year. Having obtained the motor, we do not install it on the machine tool but immediately revise and modify it.

I. M. Volkomirskiy: Yes, quality should be improved. It is dropping for many reasons. The wages of miners were raised and we were losing highly qualified workers to the mines. The plant is located in the very center of the Kuzbass. Another reason for the low quality of our products is that the plant operates in an extremely unrhythmic manner. And not only due to a shortage of personnel. The problem is still being carried along as to who will provide the raw material for the permanent magnets--the most important part of the motor. We had a shortfall of 500 articles in 1980 due to a shortage of raw material alone. It is recognized in all documents that the situation is poor with respect to raw material. And Gosplan has been calmly looking at the fact that Mintsvetmet [Ministry of Nonferrous Metallurgy] and Minkhimprom [Ministry of the Chemical Industry] have been corresponding about this for five years now.

Generally I would have to say this. The Fanuk Company produces 1,500 motors annually. The no less well known Siemens Company produces no more than 3,000. They expect 50,000 from us! This is an enormous number and it requires that production be organized in a completely different manner. To do this, construction of a plant with an area of 20,000 m<sup>2</sup> is planned. The pilings have only been driven in at present. What do you want of us?

And you try to produce a new item without a production base! We have made two modifications of the high-torque motor within 5 years. Agencies, including machine tool builders, bought some drawings and are attempting to organize production. Is this good or bad? Obviously, it is not bad. Diversification is developing throughout the world. I feel that if Minstankoprom had been interested at one time in high-torque motors that the problem would have disappeared more quickly.

Of course, they can say that the delays for a motor are 2-2.5 times greater at the plants of other agencies. This goes without saying, because expenditures are being made in one sector and a saving is being achieved in another. The electrotechnical industry is producing these motors without additional appropriations and areas, while the machine tool builders and customers are reaping the saving and a very substantial one at that. Capacities are being saved--even now the gearing of machine tools has been simplified and their many parts, for example, reduction gears and other gear components are simply not required. It would seem that some overflow of capacities and capital investments should come to our sector. This is not happening. Obviously, the economists should think about this.

A. D. Pozdeyev, doctor of technical sciences, director of the Scientific Research Institute of Relay Building, Cheboksary:

During the 10th Five-Year Plan, Minskelektrotekhprom completed 182 developments for machine tool builders. Some of them are already in production. A plant was purchased for manufacture of heavy-current equipment from foreign license. As is known, it is being used extensively by the machine tool builders. The entire nomenclature of this equipment will begin to be produced during a year or year and a half. The third generation of DC thyristor electric drives has been developed and four plants have begun to produce them.

I feel that the problem of the main drive will be solved in the near future by using AC valve-type motors, on development of which we are working. The plants of the sector are also involved in DC motors based on permanent magnets and the Novosibirsk workers are involved with an AC deep-control asynchronous motor. Our scientific base in the latter machines is not less than that in other economically developed countries.

V. M. Kozin: The asynchronous motor is advantageously distinguished in speed and oral dimensions. But what is speed? The speed of machining parts can be increased a minimum of 3-4-fold in proportion to an increase of it. One can reduce the output of power transformer equipment.

We suggest that our cooperation with Minelektronprom and the plants of Min-elektrotekhprom permits us to organize production of complete equipment, including a ChPU system, deep-control asynchronous motor, integration unit, all types of sensors and devices, that is, a complete set that removes all concerns of the machine tool builders. To do this, we are developing production of complete equipment on the basis of the experimental building of the Sibelektrotransmash Plant. We are now developing the technology which will permit us to increase labor productivity 3-5-fold. Efficient equipment alone will help to cope with this problem. Designs of automatic monitoring devices during installation and assembly have been developed. Robots will work in some sections, specifically in painting. It is interesting that a unique machine tool for manufacture of printed-circuit cards has been developed in our organization at the juncture of electronics and machine tool building. It does not contain the usual mechanical assemblies and it rests on an air cushion and a granite base. We hope to solve all problems with production of this high-production equipment during the 11th and 12th Five-Year Plans.

A. D. Pozdeyev: The existing incentives system does not create interest of plant workers in developing new equipment. Take the statistics of our industrial associations: the fraction of bonuses for production of articles with high category of quality does not exceed 10-15 percent. The remaining portion is for fulfillment of the plan and reduction of cost. Everyone knows that the more stable production is, the higher fulfillment of the plan is.

With these types of incentives, it would take three years to develop machine tool control systems! And it happens that new developments require 2-3 years before serial production of them begins. I am confident that the great interest of ITR [Engineering and technical personnel] would accelerate this process.

Moreover, incentives have been directed differently at the plant and at scientific research institutes included in a single NPO [Scientific production organization]. At the plant it is mainly for fulfillment of the plan but at the institute it is for new equipment. It is natural that the plant workers, even good people, do not rush after innovations.

V. M. Kozin: But we do not have these problems. We have others: how to successfully cope with production? It is true this is related to the certification system for the Emblem of Quality and with bonuses that have a limited operating life, after which the articles are transferred to a lower category and the enterprise, attempting to relieve itself of them, requires a replacement of us.

A. D. Pozdeyev: We are making calculations, but new equipment is introduced slowly. I am not confident that everything is good at Novosibirsk. Yes, they do pay for quality at the plants, but very little. The main thing is quantity and the plan.

V. M. Kozin: I can only say that come and look for yourself! We possibly have specific conditions, but matters are quite different: developments are not lying around.



G. A. Kulagin: But why are we complaining about high-torque motors and about electric equipment? Where is the final result for which a bonus is paid? Or is all this just "chemistry?"

V. M. Kozin: There is no "chemistry" whatever. The calculation is based on the customer's saving.

Comment: This saving reassures the customer, including Minstankoprom (laughter). I also wonder in these fields. At the end of the year I come with papers on the saving from our developments. The chief accountant does not want to look at them but the chief economist signs them. Is this the way at your place as well?

V. M. Kozin: I invite you to come to our place and see for yourself.

Yu. Ye. Nesterikhin, corresponding member of the USSR Academy of Sciences, director of the Institute of Automation and Electrometry, Siberian Department, USSR Academy of Sciences, Novosibirsk:

I would be interested in hearing the interpretation of these contradictory and complex problems. Some of them have arisen due to our confused structures that gave rise to the deep roots in industry and now these ailments are hard to treat. For the same reason such brave words as the "systems approach" frequently have no meaning. Specific programs have been divided into a number of agency pieces.

Another aspect of processes with which they have not yet been able to cope is related to the scientific or rather the anti-scientific approach to a completely new type of machine tools which the scientific and technical revolution gave birth to. Some people can very easily throw around such words as microprocessor and convert them to their own type of slogans without understanding that mankind has created a new type of machine tool--the computer. And without understanding this they do not know how to work with the new machine tool.

A. G. Aganbegyan: Thus, what are the problems of utilizing the advances of science and developing a scientific base? It makes sense to consider how they are being solved.

#### Utilize Scientific Developments

Yu. Ye. Nesterikhin: Yes, there is still sufficient development of ideas and engineering solutions in science to cover the entire cycle from design of an article using a computer to manufacture of articles on machine tools with ChPU. This is achieved by using a standard system consisting of different devices and machines made in the international standard of CAMAC. This is a very flexible structure which can be rearranged and developed. It is based on standardized independent program-control devices--modules standardized in composition and the method of exchanging information with each other and also with any computer.

How does this system operate with regard to circuitry? At the upper level, let us say in the machine tool building KB [Design office], there is a computer which helps to model the design as a whole. You then take the level lower--prepare drawings and articles and solve specific design problems. Machine tools with ChPU controlled by microprocessor computers are connected directly in this scheme, at the third level. Having completed assembly, you sometimes return to individual parts, correcting them directly on the machine tool. Then, by making the first version, one can always air both in intermediate drawings and in the design and during the course of the production process.

It is important to combine all three levels into a single complex. This is possible only by combining different computers. We have each agency if of course we can invent our own methods and devices for integration of sensors and computers. Their pilot institutes can bravely record these "achievements" in their archives. What kind of CAMAC are they! Moreover, they are an inter-agency standardization!

The standard is related not only to "iron" but to mathematics as well. I would be pleased to hear that the participants of the roundtable understand the significance of "soft goods." First, its price is now high--more than half the cost of devices. And we frequently, when talking about automation, imagine as before something related to metal. When software is developed, automation becomes efficient and vice versa. Second, software has also been standardized in a modular manner worldwide. If it has not assume that your resources have simply blown away. There can be no system of only one plant as there can be no computer which can let us assume be a Severodonetsk machine.

When systems based on CAMAC become realistic according to the decision of central organizations, we can create entire technologies from beginning to end. We of the institute have been knocking our head for more than 10 years against a method of indirect technology. True, it exists in laboratories. But unfortunately there are uncertainties in life such as ASU-design, individual ASUTP [Automatic production process control system] and individual machine tools with ChPU. All are the same. Whoever is in the forest is after wood. The engineering base of these systems is restored every 5-6 years but there is no way to formulate an integral approach.

It will soon be three years since the CAMAC began to operate in the country. To introduce it, rather severe efforts were required at all levels of management. However, it is obvious that more time is required so that public consciousness is shifted in the necessary direction.

They can reproach me for the fact that I grow all the time on general topics and seem to forget about machine tools, ChPU and electric drives. But others, arguing about the types of machine tools and the makeup sets, turn all the time to general problems of management of scientific and technical progress. This is valid. Without solving these problems, one will systematically encounter them.

A. Ye. Prokopovich: We are now strengthening cooperation with academic science. Together with the Presidium of the USSR Academy of Sciences and the republic academies, we are working out specific long-term programs for 15 years. These measures are supported by the State Committee for Science and Technology. The system of planning new technology should be divided into three phases: delivery to industry now, engineering preparation for the next five-year plan and development of fundamental preparation for the long term.

Zh. A. Mrochek, candidate of technical sciences, deputy director for scientific work of the Physicotechnical Institute, BSSR Academy of Sciences, Minsk:

It is gratifying to hear that Minstankoprom is thinking about development of scientific progress. For a long time the sector treated us, mildly speaking, not quite loyally. And only recently have two representatives of this ministry visited our institute at the request of the republic Gosplan and we have agreed on a plan of joint work.

A scientific section must not only be developed but also used. Design is not included in the function of an academic organization, otherwise academic institutes will expend many efforts on this and science will suffer. But it actually turns out that both design and introduction lie on our shoulders if we want to see our development in production. Moreover, it has been easy until now to reach agreement with other machine building sectors, even with machine tool building. And our developments have been the light in those very sectors although they were designed for machine tool building.

The institute is developing equipment to implement a number of promising metal-working processes: magnetic-abrasive polishing, surface-plastic deformation, rotary cutting, hydraulic impact stamping and electroerosion machining. The problem that an experimental plant could be constructed at the expense of interested ministries which would produce equipment from the developments of our institute was discussed. The decision has been postponed for the time being but obviously an NPO can be created at our institute, including in it an SKB [Special design office], experimental plant and a small-series plant.

An All-Union Scientific Research Institute of quite different profile has developed an installation from our technology of magnetic-abrasive grinding. Our institute has received an inventor's certificate for the method and they have received one for the device. Machine tools based on a new method are being manufactured by instrument builders and aviation builders. It was assumed that their production was organized at the Derbent Grinding Machine Tool Plant of Minstankoprom, however the decision is being drawn out. But after all polishing still mechanized on a low level. This operation is usually performed manually and a large number of workers is involved in it.

Or, for example, take transverse-wedge rolling. The use of this production process instead of lathe machining accelerates many times the manufacture of parts and reduces metal wastes. We have developed a transverse-wedge rolling mill for small rollers. We have not found understanding among machine tool builders, but the Yartsevo Casting-Machine Plant, Minlegpishchebytmash [Ministry of Machine Building for Light and Food Industry and Household Appliances], has reacted with high approval for this development. They have ordered this machine tool from us.

The need for transverse-wedge rolling mills is great but the institute's capabilities are limited. When enterprises appeal to us we advise them to acquire equipment in the GDR and we help them to assimilate the production process and make adaptations. We rendered this assistance to the Minsk Tractor Plant, the Zaporozha Automotive Plant and the Lida Agricultural Machine Building Plant.

But there is the capability of developing wedge rolling mills, for example, at the Pinsk Forge-Press Line Plant. We have reached an agreement with the plant but have not received authorization from Minstankoprom.

The special design-production office developed at our institute now designs and the experimental plant produces machines on orders of the republic enterprises. It has been proposed that a wedge rolling shop be developed at Lida since there is a great need at the plant for chain links for a potato-harvesting combine.

The All-Union Scientific Research Institute of Metallurgical Machine Building (VNIIMetmash), Volgograd Division of the All-Union Scientific Research Institute of Tractor Machine Building and the Experimental Scientific Research Institute of Forge-Press Equipment (Voronezh), which is the pilot institute on this problem in Minstankoprom, are involved in problems of metal rolling.

We are specialized in development of small rollers, they are specialized in large rollers at the VNIIMetmash of Academician A. I. Tselikov and they are specialized in medium rollers at a third plant. There is no duplication nor is there coordination. We are possessed by the idea that machine tools for rolling developed at the pilot institute have not been produced.

Yu. Ye. Nesterikhin: I think that much rests on the monopoly of the sectors and their pilot organizations. Cannot the same thing happen with makeup units? I feel that Minelektronprom does not wish to give anything better to Minpribor or Minelektrotekhprom because everything relies on monopoly. If I made a good circuit why should I immediately give it up? And on the other hand, if someone made a good one, why should I not recognize this immediately? After all, I can make a better one in the future!

Zh. A. Mrochek: I would still talk about similar difficulties which the institute is experiencing in introduction of electroerosion units (thanks to Minavtoprom, production of them was organized for the entire sector at the Borisovo Truck-Tractor Electrical Equipment Plant), rotary cutting and many other of our developments. One thing is clear that the scientific section is being underutilized and coordination is required both to overcome the difficulties and agency barriers and the resistance of the pilot institutes. We expect that the State Committee for Science and Technology will play a more active role in it.

Ye. G. Nakhapetyan, doctor of technical sciences, professor of the Institute of Machine Science, USSR Academy of Sciences, Moscow:

The methods of analyzing the quality of equipment are underutilized in machine tool building. Attention is frequently turned only to the speed of individual



mechanisms and what is essentially required from a given type of equipment is not taken into account. It is purchased from those companies which guarantee higher indicators in the speed of machinery. We have found during investigations that many companies plan to deliver unjustifiably accelerated equipment in order to maintain the competitive struggle and it is distinguished by low reliability.

The idea of diagnosis was heard here only in N. A. Smirnov's appearance and only then because our ChPU systems are unable to diagnose the systems themselves. We clearly lag behind worldwide practice in this and the lag is even increasing. After all, machine tool control systems cannot perform these operations if the diagnostic parameters have not been selected, there are no information processing algorithms and no extensive research is being conducted. Life has advanced the problem of developing production sections with non-human technology. Reliable diagnostic systems, without which they will generally not be able to operate, are required for these sections.

Our institute has accumulated extensive material as a result of investigations at VAZ, but very few plants have shown an interest in it. The machine tool builders and designers frequently come almost unarmed to VAZ to study equipment--with a notepad and in the best case with a timer.

But there is experience in machine tool building of diagnostic checks of equipment. For example, diagnostic methods of control were applied at the Moscow Plant imeni Ordzhonikidze and the Moscow Special Machine Tool Plant. It turned out that the precision of the rotary benches of modular machine tools is four times higher than that at similar enterprises where technical diagnostic methods are not used. When ENIIMS applied for certification for the Emblem of Quality, specifically by checking specific dynamic parameters, the Moscow Special Machine Tool Plant appealed to us. A system was developed that reveals flaws during testing. However, to introduce the system the institute had to make sensors--our industry does not produce them. At one time even foreign representatives came to us to study. Now tens of them produce these sensors.

Comment: They learned how to.

V. G. Nakhapetyan: Yes. They made sensors and they must be certified at the House of Weights and Measures, but they did not have the equipment there and no one is planning to produce these sensors in the required nomenclature. But someone should be responsible for the use of the scientific section and for coordination of the efforts of all agencies in this direction!

A. G. Aganbegyan: A few words in conclusion. The existing economic mechanism, the organizational structures in the national economy and the system of levers and stimuli were established historically. This indeed does not fully correspond to new problems of production intensification and in some ways even inhibits solution of them. We can again ascertain this on the example of machine tool building. The machine tool stock is dispersed, the use of approximately half of it outside machine building is extremely inefficient, machine tools frequently operate 3-4 hours per day (if you consider full operation),

only 0.7 machine tool operators is required for each machine tool--all this is the misfortune not only of machine tool building. This is a complex question related to improvement of the economic mechanism, to establishment of economic ties and doing away with natural economy.

But the general aspects should not be exaggerated in this case and one should think that nothing depends on a single sector, that when everything is okay then we will work efficiently. Even so, as we ascertained here, much depends on each sector and on each plant. The example of the Ivanovo machine tool builders confirms this. Like others, they could make a routine product. But the association has selected a very unique path and from my viewpoint a very effective one, although hard. And this shows how much the sector can do, especially if it, like machine tool building, occupies a key position in economics. Of course, this is done with the active support of related workers. I feel that all their capabilities must be realized. The decree of the CPSU Central Committee and the USSR Council of Ministers on increasing the technical level and competitiveness of equipment was directed toward this realization.

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## METALWORKING EQUIPMENT

### DEVELOP MOBILE PRODUCTION

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian  
No 1, Jan 82 (signed to press 14 Dec 81) pp 87-106

[Article by V. P. Kabaidze, general director of Machine Tool Building Association imeni 50-letiya SSR, Ivanovo]

[Text] The establishment of a world-class machine tool building plant in the Ivanovo age-old textile region and even more so within such a limited deadline --approximately tens of years--is its own type of phenomenon which requires explanation and comprehension.

The products of the Ivanovo Machine Tool Building Association imeni 50-letiya SSSR has now won its position among a number of articles of many leading companies on the international market of metalworking equipment. The largest electrotechnical enterprises of Japan, West Germany and Sweden cooperate with the Ivanovo workers and deliver makeup units to them to equip machine tools. Soviet machine building enterprises are attempting to acquire machining centers with the mark of the Ivanovo Machine Tool Building Plant. They frequently ask for the assistance of its specialists and their consultations in those cases when difficulties arise with introduction of the most complex metalworking equipment into operation. In short, the Ivanovo association has already established the reputation of one of the leaders of modern machine tool building.

But the path to acceptance was far from easy. Initially there were few who believed in the attempt undertaken by the managers and collective of the enterprise to emerge to a worldwide level. And it seemed the skeptics had every basis: the plant at Ivanovo seemed to construct a duplicate of the Leningrad Machine Tool Building Association to smooth out the demographic disproportions and copies of serial machine tools developed by other enterprises. There was neither a scientific research base for machine tool building, nor traditions nor personnel.

The plant very possibly would have become a core enterprise which would conscientiously follow the machine tool "specimens" from foreign designs if the plant director Vladimir Pavlovich Kabaidze, appointed 11 years ago, had not been able to see the new prospects for development and had not inspired the collective with them.

The experience of the Ivanovo workers is proof of the enormous capabilities hidden in the initiative of the production collective itself. With it referring to the shortage of personnel, the absence of materials and machine tools, they proceeded toward the intended goal--development of machining centers at the level of the best worldwide models. Now when they have taken a course toward intensification of production, the national economy especially needs this equipment.

A multioperation machine tool or, as it is called, a machining center, is a complicated machine with numerical program control that immediately replaces several machine tools. A machining center produces a part ready for assembly from a blank, moreover made with high precision in an automatic mode controlled by a program. Machine tools are freed, qualified workers are freed and the process of production management is improved since there is no need to separate the machining of parts into many operations performed on different general-purpose machine tools, which generates difficulties in planning and control over the course of production.

The general director of the association, V. P. Kabaidez, in the article published below, talks about the engineering and organizational decisions due to which the association managed to emerge to the world level of product output and also about the problems which the enterprises proceeding on this path will encounter.

The time factor plays an enormous role in developing competitive equipment along with the engineering level. We feel that production of machine tools should be mobile, that is capable of being rapidly readjusted to development and manufacture of new machine tools according to the requirements of scientific and technical progress and the requests of customers.

It has not been easy for us to follow this production ideology and sometimes it has been trying, but we do not see any other path to maintain the worldwide level of products.

The plant is still young. The first machine tool was produced 15 years ago. The enterprise was constructed as a duplicate of the Leningrad Machine Tool Building Association imeni Ya. M. Sverdlov. However, life has introduced corrections. At the same time, when the Ivanovo workers began to produce thousands of general-purpose boring machines annually, the country was saturated with this type of equipment. The plant lived under exceptionally severe conditions. Many probably recall the articles in EKONOMICHESKAYA GAZETA at the end of the 1960s and the beginning of the 1970s: "Shall We Sell General-Purpose Boring Machines 2620 Without Stock and Parts"?

I became acquainted with the enterprise at this time. After the Ryazan' Machine Tool Building Plant where I was the chief engineer, the situation at Ivanovo seemed depressing. The prospects for development of the enterprise by Minstankoprom [Ministry of the Machine Tool Building Industry], let us say directly, was not resolved in the best manner. With its left hand they began to get rid of everything at Ivanovo that had gone poorly at other plants; the



production of obsolete radial drilling machines from Odessa, pipe-cutting machines from Tbilisi and so on found their way here. The enterprise had six product developments, neither one related to the other, and its design office was both weak and poorly staffed.

The newly constructed plant found itself in such a complex situation because they "pleaded for" prospects during its development. In general, life was hard but the future had to be thought of and it gained its own face. The plant had a serious patron--the Leningrad Machine Tool Building Association, for which it was easy to become involved in this cauldron with trading in boring machines since its mark enjoyed respect and product quality was high.

We selected the future although complicated path of development: begin production of machine tools with numerical program control (ChPU) so as to later convert to production of machining centers (OTs) and thus to create conditions for rapid development and production of new equipment.

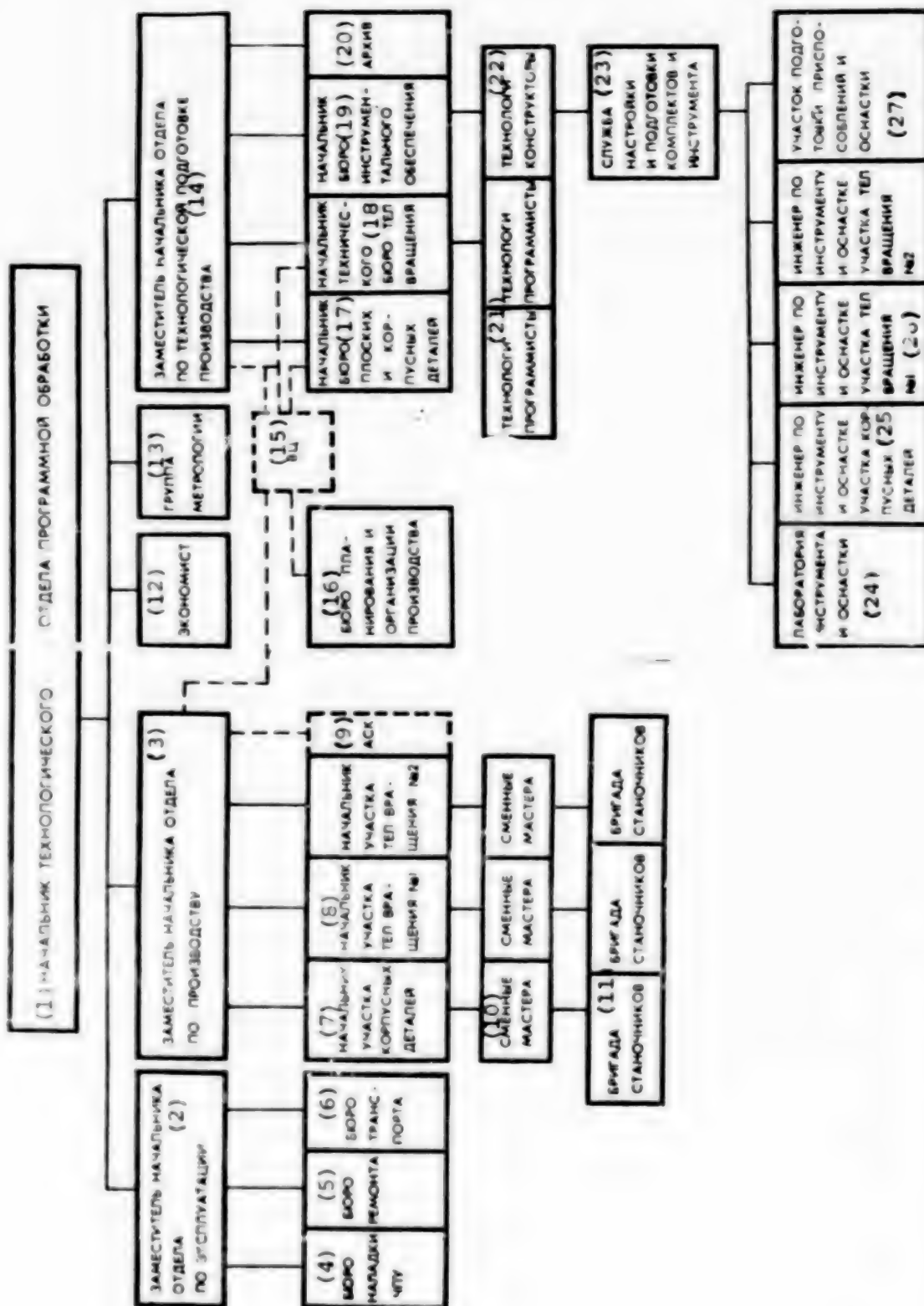
There were many skeptics who shrugged their shoulders and laughed maliciously: the "duplicate-plant," located in the provinces, is making the simplest general-purpose machine tools from foreign designs, but will immediately break into the legislators of the machine tool building mode!

We did not in any underestimate the expected difficulties. But the managers and the plant collective were firmly convinced that it was necessary to begin a fundamental restructuring now before any gain was required. If we expended our efforts on the plan and service, then it would be very difficult to again set everything in motion.

They began work immediately in several directions: design of machine tools with ChPU, technical re-equipping of the plant, restructuring of the production technology and organization and development of a new system of relationships with the customer plants.

We devoted the entire Ninth Five-Year Plan to technical re-equipping. According to the initial plan, there were no machine tools with program control at the plant and there was very little equipment for finishing operations, that is, all that which determines product quality. We first purchased machines for finishing operations and then began to equip ourselves with Soviet and foreign machine tools with ChPU which we managed to acquire at international machine tool building exhibitions held in our country. More than half of our equipment stock with ChPU was machines of our own manufacture, beginning with our firstborn--the 2611F. We have the following principle: all prototype machine tools that we produce are kept with us. Two factors then go into effect: first, we equip ourselves and second the designers see their machines in operation and know without cheering about it the problems and difficulties of operation. And they are inevitable, especially when producing the first prototypes. The machines which follow the adjusting series are developed on the experience of using it.

We made the first machine tool with numerical program control in 1973 in cooperation with the Novosibirsk plant Sibelektrotransmash and the Novosibirsk



Structure of Programmed Machining Production Department of Ivanovo Machine Tool Building Association

Note: The dashed line denotes the developed automatic machine tool complex (ASK) and control of it.

[Key on following page]

Key (Continued from preceding page):

1. Chief of programmed machining production department
2. Deputy chief of operations department
3. Deputy chief of production department
4. ChPU adjustor office
5. Repair office
6. Transport office
7. Chief of housing parts section
8. Chief of rotary body section
9. Automatic machine tool complex
10. Shift foreman
11. Machine tool brigade
12. Economist
13. Metrology group
14. Deputy chief of department of technological preparation of production
15. Computer center
16. Planning and production organization office
17. Chief of flat and housing parts office
18. Chief of rotary body engineering office
19. Chief of tool support office
20. Archive
21. Programmers
22. Designers
23. Complete set and tool adjustment and preparation service
24. Tools and fittings laboratory
25. Engineer for tools and fittings of housing part section
26. Engineer for tools and fittings of rotary body section
27. Accessory and attachment preparation section

Scientific Research Institute of Multiple Electric Drives. Unfortunately, up to the present this cooperation has remained the only example when a complete set of electric equipment is supplied with ChPU.

Having made the decision to convert to production of multitool machine tools with numerical program control and automatic changing of tools of the "machining center" type, we also attempted to use Soviet makeup units. However, having manufactured the prototypes and having checked them in our own plant, we became convinced that it was not worth offering them to customers.

The engineering level of a modern machine tool, especially of a machining center, is determined by 50-60 percent by electric principles, electronics and hydraulics. Neither the Novosibirsk makeup units, and we felt they were good ones, nor others as well could provide these equipment characteristics due to which it was worth developing a machining center. And even so the vicious circle of fruitless conversations of who was ready and who was not ready to produce machining centers--machine tool builders or suppliers of makeup units--had to be broken. We attempted to do this. We purchased a ChPU system from the Siemens Company and manufactured on its basis a multitool boring machine with automatic changing of tools of the "machining center" type--the IR-500 (it was designed to machine parts measuring 500 centimeters long, wide and

Dynamics of Producing Machining Centers by the Ivanovo Machine Tool Building Production Association

	IR-500MF4	Module 500	IR-800MF4	IR-500PMF4	IR-1600MF4	IR-320MF4
Precision class	N	N	N	P	P	P, V
Number of controlled coordinates, units	3	3	3	4 3	6 5	5 6
Bench dimensions, mm	500 X 500	500 X 500	800 X 800	500 X 500	8,000 X 2,000	320 X 320
Number of satellite benches, units	2	8	2	2	2	4
Spindle rotational frequency, rpm	21.2...3,000	21.2...3,000	21.2...3,000	(32...5,000) 21.2...3,000	5...2,000	40...5,000
Number of tools, units	30	30	30		60	40
Amount of lubricants delivered to cutting zone, liters/min	20	20	20	20 40	60	140
Enclosure of cutting zone	--	--	Yes	Yes	--	Yes
Air cooling of spindle coupling	--	--	--	Yes	Yes	Yes
Weight, ton	11	14	12	11	120	7



high). The machining center gained approval at the Stanki-77 exhibition devoted to the 60th anniversary of the Great October Revolution. This same year we demonstrated the second machine of this modification at the international exhibition in Hanover. It was purchased by the Bosch Company (West German).

One year was required to produce the first machining center--from the beginning of design to production, whereas 4-5-fold more time was expended previously to develop less complicated equipment.

What led to such a sharp reduction of cycle of developing new equipment; primarily the fact that we rejected the principle of phase management of work. Earlier, designers created "paper"--drawings--for 1.5-2 years and then turned it over to technicians. These people worked out the production processes and ordered the new equipment required to machine parts, materials and so on. Production of the new article was begun after 3-4 years. We combined the steps of developing the machine design, engineering preparation and startup of larger--basic--parts. To do this, the machine tool was seemingly "cut" into its basic components. Assemblies are designed by the modular method, that is, each of them should be a finished whole insofar as possible and should be autonomous, as, for example, an automobile engine or gearbox. Production and testing and improvement of the design then become more dynamic.

Working out the technical documentation assembly by assembly and starting to produce parts were carried out on the basis of network schedules. Technicians and metallurgists work at drawing boards simultaneously with designers. If disagreements arose, they were resolved the same day by the plant management. As a result the design of the first machining center was begun on 3 January 1976, drawings of the frame were issued on 15 April, a model of the frame was turned over to the casting shop on 23 April and the first two castings were ready on 30 April.

Measures were adopted simultaneously to consolidate designer services. A machining center section was created in a special design office. A research laboratory and engineering calculation section was developed which operate for the future. True, they do not now quite satisfy us. We do not yet have any experimental production and it should proceed before serial production. Let us assume that during beginning reconstruction of the plant we first introduce the engineering and experimental building so as to accelerate development of the scientific and technical services of the association.

Serial production of a machining center required new methods of organizing the assembly and adjusting of these machines. The technology of assembly tests that simulates operation of assemblies was worked out. The designers in cooperation with technicians developed special electronic assembly benches which permit the assemblies to be checked in the operating mode. For example, there are autonomous test programs for the manipulator-robot and tool magazine, head stock, satellite tables and other assemblies. The test cycle is reduced because of this by one-half on the main assembly bench. Adjustment and checking of the finished machine tool for accuracy are now mainly conducted here.

Certification of assemblies has been introduced to increase responsibility. One can learn from the document which accompanies the assembly through all

production phases to main assembly of the machine who prepared it and who tested it on benches and who is fundamentally responsible for its quality. These methods of assembly and testing were introduced in the country for the first time. The assembly cycle was reduced from 4 to 2 months because of them. We feel that we can reduce it to one month.

Machine shops have learned how to maintain the tempo controlled by assembly due to the fact that more than half the parts are machined on machine tools with ChPU, although they comprise one-fourth of the machine tool stock. The number of our machine tool operators did not increase in this case since we attempted to sell low-productive general-purpose machine tools. All equipment with ChPU (there are 130 such machines at the plant, including 23 machining centers) is concentrated in a special software production department (TOPO). The department has production, repair and engineering subdivisions and itself works out the production process for programmed machine tools and executes the process itself. There are more than 500 persons in the department, of which 300 are workers and the remaining are engineering and technical personnel. Our great dream is to bring the fraction of programmed machine tools to 90 percent in machining. The development of our own stock of machine tools with ChPU became one of the most important factors of increasing the mobility of production.

With regard to worldwide standards of precision and reliability, we had to increase requirements on the quality of machine articles regardless of whether they were ours or imported. Input control is now exercised at many of the country's enterprises. This is not new. But we were forced to organize a prefinishing section. Some things have to be completely sorted out and others require less finishing. But this operation is required regardless, especially with respect to electric drives, hydraulics and bearings.

Having combined many phases in time--design work and technological preparation of production, casting basic parts and manufacture of laborious assemblies, assembly and testing--we reduced by a factor of 3-4 the deadlines for design and manufacture of machining centers. Five years have passed since we began to produce them. During these years they have undergone a number of design changes. Accuracy has been increased, the working principle of the tool holder has been changed, a more intensive cooling system is used and safety conditions have been improved (the cutting zone is protected).

Since the development of the SKB and even prior to 1976--before the beginning of work on machining centers, our designers had a total of five inventors' certificates. They received 50 certificates during the 10th Five-Year Plan. The main inventions are related to machining centers--configuration decisions and spindle and table designs. We have a satellite table for the machining center, due to which the preparation time is considerably reduced and the net machine operating time of the tool is increased. Parts are machined on one table while another part is being adjusted on the other.

The engineering level of the machine tool is determined by the machining speed, travel speed of working members, the level of machine tool automation and the reliability and accuracy of machining. They are not inferior to

foreign products in all parameters, as shown by a check of our machine tools by foreign companies.

When we talk about the economic effect from machining centers, attention is turned toward the increase of labor productivity, the high precision of machining and reduction of the number of machine tool operators. Actually, a machining center increases the machining productivity from 3 to 20-fold as a function of the parts being manufactured. But there is yet another important advantage of using them. This is concentration of operations. Parts do not have to be transferred from machine to machine and one does not have to follow their movement. Because of the multitool magazine, almost the entire process of machining a part is concentrated on a single machine tool. The number of personnel engaged in accounting and control of machining of parts is reduced and production management is improved.

And even so with the undoubted advantages of the IR-500 and other machining centers, they still had one deficiency which we are trying to overcome in subsequent designs. The fact is that the operator cannot be taken away from this machine tool. One operator can be allocated for 2-3 IR-500 machines, but you cannot get along without him. New design developments were required to completely convert to non-human technology, to development of automatic machine tool sets and apparently our industry required these solutions with regard to the shortage of labor resources.

One of them is embodied in the module of the IR-500. We provided eight storage cassettes in which parts can be delivered in turn to the machine tool for machining. The average length of machining parts on this machine tool is approximately one hour. Thus, if the machine tool is loaded at the end of the second shift, the entire night shift can run without stopping the machine tool. This equipment is widely acclaimed in the west for operating during night shifts. The number of people in a section where it has been installed can be reduced to a minimum.

Modules are closed cells of the production section. Automatic production can be configured from them. We used the IR-500 modules in development of an automatic machine tool complex (ASK) at our own enterprise. Automatic feed of blanks for machining and transport of the finished product to the warehouse and development of automatic warehouses were additionally thought out for the ASK.

We solved the problem of removing cuttings from the cutting zone in the module-320 machine tool--our smallest machining center, which is called "our kid," in the association. This is a very important step in developing non-human technology. A vertical table has been designed and the cuttings fall directly on a conveyor. The cutting zone is completely enclosed. Working and safety conditions were improved. Moreover, the vertical table is rotated at any angle and there is the capability of performing operations on housing parts for which turning and vertical turning lathes were required.

The module-320 has four interchangeable satellite tables available. The adjuster can load the tables every four hours with parts for machining. The

cuttings are removed automatically. The module-320 can be serviced without an operator.

And finally, our designers are now involved in embodying yet another interesting engineering idea--development of unit centers in which the flexibility of a multitool machining center and high productivity of an automatic line will be combined.

Entire automatic lines rigidly adjusted for specific parts must be disassembled and replaced in serial and continuous mass production during development of new articles. Unit centers should give flexibility to equipment. To do this, multispindle heads can be used--several rather than one tool will participate immediately in machining. Unit centers can be linked by a transport device to the automatic line which is already flexible and capable of rapid readjustment.

It is difficult to overcome inertia. It is felt in the sector that modular machine tool plants should be involved in unit centers. But first they have to pass the step of developing machining centers. At the present time and efforts of our designers go to proving the need for unit centers and the capability of producing them in our association. After all, we have already tested many design solutions: multispindle heads were used on IR-1600 machine tools--the largest machining centers not only in our country but in the world, technical procedures for changing satellite tables were developed in IR-500 and 320 modules and so on.

We gained the capability of manufacturing machining centers only due to the fact that we managed to overcome the psychological barrier of distrust of customers. After all, customers should believe us to the extent that they are transferring part of their currency to us. Our customers ascertained the advantage of our suggestion: do not buy equipment from foreign companies but only some makeup units for it and primarily programming devices. Foreign currency outgo is reduced by a factor of 5 by doing this. There can be five machine tools of the same class instead of one. Essentially, a programming device comprises approximately one-fifth of the cost of a machine tool and the remaining four-fifths are paid for for "iron," which our machine tool building plants can do properly.

We have been producing machining centers for more than five years now. Unfortunately, we have not managed during this period to take a single position from imports except hydraulic, which we began to receive from the Gomel' Machine Tool Assembly Plant. The absence of makeup parts, and no one now doubts this, is the main obstacle to development of modern machine tools, especially the absence of programming devices with feedback components, high-torque motors, and high-speed bearings. The need for high-torque motors is not being satisfied in the country, while the world is turning from them to deep-control high-frequency asynchronous motors. We ourselves have even taken on production of "high-torque motors"--no one knows what a complicated piece that ChPU systems are. But no one supported us.

It is especially insulting when we must purchase that which is available in the country but in insufficient quantities. For example, main drive motors



are manufactured at a rather good level at Prokop'yevsk, but there is a shortage of them. The same is true of high-speed bearings. Having prestige in methods of producing high-quality steel by the electroslag remelting method developed by the Institute of Electric Welding imeni Ye. O. Paton, Ukrainian SSR Academy of Sciences, our enterprises could expand production of high-speed bearings.

At the same time the question whether we should do it ourselves and whether it makes sense to completely reject international cooperation is valid. The fact that we can purchase on a mutually advantageous basis on the foreign market makes us feel that we should purchase there. However, only on mutually advantageous basis. The experience of our cooperation with foreign companies has demonstrated that it provides a known benefit. Every year they propose new generations of ChPU systems to us like to their other partners, and thus we were forced to become oriented to the most advanced electronics, become involved in mobile production and operationally introduce design changes.

The next problem is tooling accessories of equipment. There is the concept "outfitting factor." The cost of all accessories given to metalworking equipment comprises 30-40 percent of the cost in worldwide practice. We are attempting to adhere to this ratio. The Krasnyy proletariy plant is close to it. However, the outfitting ratio is at the 3-5 percent level on the average in Soviet metalworking equipment.

We developed a program with respect to tools for the machining center but did not find executors. We had to manufacture a large part of the tools ourselves. Even those 11 positions which the Ministry of the Machine Tool and Tool Building Industry scheduled for their own plants are manufactured in insufficient quantities. We were ready to take any tool plant into the association and specialize it for production of tools for all machining centers of the sector. But a bureaucratic mentality interfered even in our own ministry. The Ivanovo plant is related to the VPO [All-Union Production Association] Soyuztyaznostankoprom, but the tool plants belong to another All-Union production association which is afraid of becoming lost in enterprises.

Construction of production accessory and robot plants has now begun in Ivanovskaya Oblast, which associations are including in their composition. But funds are being poorly allocated and the capacities of the construction organizations are insufficient. We can hardly count on these enterprises during the 11th Five-Year Plan. Undoubtedly, there should be a positive effect in the future that machine tools, manipulator-robots and tools will be in the same hands.

What is the way out of this situation today? I think that nothing more can be gained except a "tool bank." I am suggesting that customers develop this bank on a cooperative basis. Some should take on themselves manufacture of auxiliary tools, some should take on manufacture of cutters, others should take on manufacture of drills and so on. There will then be specialization in manufacture of tools and considerably lower expenditures than if each one tries to do everything himself. There is a Sigma ASU user association in the Siberian Department of the USSR Academy of Sciences, as I learned from EKO, which operates on the following principle: each one introducing this system contributes

# Approximate Composition of Accessories for IR-500 MF4 Machining Center

<u>Name</u>	<u>Manufacturer</u>
General-purpose mandrel (five types)	—
Microdrill head (five types)	—
Single-cutting head (six types)	—
Two-tooth boring head (four types)	—
Boring ring (five types)	—
Mandrel for headpiece end cutter (two types)	Kulyab, KOZTO
Adapter holder (two types)	Kalinin, die plant
Adapter for countersinkers and reamers	Kulyab, KOZTO
Adapter for end cutters with tapered shank (four types)	Kalinin, die plant
Short cylindrical adapter (four types)	Kalinin, die plant
Long cylindrical adapter (three types)	Kalinin, die plant
Collet chuck (two types)	Riga, OZTO; Novosibirsk, NIZ
Collet set (two types)	Riga, OZTO; Novosibirsk, NIZ
Tap chuck (two types)	Kalinin, die plant
Extender (four types)	—
Adapter (three types)	Khmel'nitskiy, KhIZ
Cutter bushing (eight types)	Lozovoye Village
Flat drill mandrel	Orsha, OIZ
Reverse counterbore (six types)	—
Boring chuck (two types)	—
Disk cutter mandrel (two types)	—
Shortened KM2 drill chuck mandrel	—
Wiper	—
Keyless drill chuck	—

Notations: OZTO--experimental production equipment plant; IZ--tool plant;  
solid line--manufacturer not determined.

something of his own. I feel that this is a very correct principle! And it is quite suitable to organization of an association of machining center customers.

Of course, 70 percent of the tools will still be made by our plant. But it is a crime to produce machining centers without tools and accessories. This "game" is too expensive so that it can only be admired in the shop.

Essentially, we must trade in technology rather than machine tools: sell not only equipment and tools but also develop technology for machining the most standard parts which the customer plans to manufacture on the acquired machine, the program and software. A service department has been created at the association which includes three offices: production, installation and adjustment of machine tools with ChPU and external installation. We are installing an installation chief, are training specialists of the customer plants in operation of machine tools with ChPU and are developing the technology and programs for the basic parts which will be machined on our machine tools. True, this system of mutual relations is advantageous only to customers since "soft goods" --rendering services to customers--is being incorrectly planned--a sufficient number of specialists for service is not being allocated. But positive changes have been noted recently: "soft goods" have at least begun to be calculated in fulfillment of the plan for commercial products. I feel that if we plan and account for labor expenditures for service during conversion to normative net production, then the services will be advantageous not only to the customer plants but to the manufacturing plants as well. Development of a service department is I feel one of the indispensable conditions for mobile, dynamic production that permits the problems of customers to be better taken into account.

An important condition of mobility is reduction of universal agreements in production of new equipment. They are now as bothersome as they are useless. A three-step visa is required of us--prior to production of the first model, then prior to the adjusting consignment and finally prior to serial production. A total of 3-4 years is required for coordination. But in the final analysis the economic manager and designer rather than the head scientific research institute or any other departments are responsible. This will relieve them of trivial custody! We have achieved at the ministry a reduction of the coordination procedure and now sign the specifications for a new machine tool only once: at the experimental model stage. However, we have authorization for only one machine. And we feel that the coordination procedure should be simplified and accelerated for the entire production of new equipment.

We have violated yet another "rule of the game." It assumes that an experimental model must first be made and then a sample lot is made. We are beginning a series immediately. This is difficult but we gain the most important thing--time.

I have now come to the most difficult section of the article: what results of production-economic activity has intensive work on development of competitive equipment brought? We have emerged onto the worldwide market. Such economically developed countries as Japan, the United States, Austria, West Germany, Sweden and others are purchasing our machining centers. There is a large demand on the internal market for our products. The portfolio of customers is full. They praise us in the press. But we have no economic advantages at all. It's no accident that not one plant has followed our example, although our experience of developing new technology was tested.

What good is new equipment and export if an enterprise can pay its engineering and technical personnel 30-40 percent of the progress when fulfilling ordinary

planning indicators? And if the tasks for new equipment are fulfilled and if the production plan is not fulfilled, there will be no incentives funds. If the task for new equipment is fulfilled, progress is reduced by only some percentage, which is obviously more advantageous for the enterprise. And each director prefers a blue titmouse in hand rather than a swan in the sky.

In order that production of new equipment become advantageous, the system of planning it and economic incentives must be improved. Manufacture of general-purpose boring and obsolete radial-drilling machine tools were planned for us from year to year. When we said that the radial drilling machines should be taken out of production and that the output of general-purpose machines should be reduced and we would then be able to increase production of machining centers, they reprimanded us at Gosplan--"if you want to manufacture more machining centers please do so but there are also orders for the remaining products." What is the role of Gosplan: to plan for the future or to distribute orders? The Soviet stock of machine tools is incredibly dispersed, the shortage of machine tool operators is acute, the equipment replacement coefficient is dropping, but an increase of the production of general-purpose machine tools is planned for us.

When planning, one must take into account how it is more feasible to load one or another plant. If an enterprise is capable of manufacturing competitive equipment, then should it be loaded with the simplest equipment which others can make?

Two years have passed since adoption of the decree on improving the economic mechanism. Even before then we began to carry on negotiations so that the plant was authorized to use experimentally the stimulating propositions for new equipment that had undergone an experimental check at Minelektrotekhprom. Their essence is now known to everyone since they were included in the decree of 12 July 1979. Moreover, no attempts of any kind are seen in our sector to accelerate introduction of the new incentives system for scientific and technical progress.

We also are unable to completely use the stimulating role of bonuses for product quality because much bureaucracy has appeared in certification of articles for the Emblem of Quality. We plan to increase the volume of products of higher category of quality due to the figure given for the sector and our proof is not taken into account that part of the product should not only not be brought up to a higher category but should be taken out of production beforehand since it has become obsolete. We are talking about radial drilling machines and some types of general-purpose equipment. And we have really been authorized to remove it from production during the 11th Five-Year Plan.

The advantage of exporting products has not yet been felt because the three-percent bonus for it, which must still be shared with the coexecutors, converts to such miserly figures that no one feels any effect from them.

Economic stimuli for new competitive equipment should be extensive. Only then will they be effective.



The association is posing the goal of developing production which will be occupied only by science-consuming machines--production of machining centers and complexes of machining centers. It has a good potential for this--a strong design office, qualified technicians and a well-equipped industry. The structure of plant personnel has changed sharply. Every fourth specialist of the Special Design Office is an electronics engineer. The workers have become tempered in mobile production and in continuous assimilation of new equipment and relate with understanding to fulfillment of this task.

If all the suggestions required to develop mobile machine tool production are summarized, I would reduce them to the following:

supplying enterprises with equipment that permits flexible and dynamic restructuring of production to solve new problems;

improvement of the planning and incentives system for new equipment;

a decisive change of the technical documentation system and simplification of the coordination procedure. Incidentally, in this case the scientific subdivisions of the sector (ENIIMS and others) are relieved of any type of formal procedures and can become more involved in their own basic business--research and new developments;

creation of conditions for development and assimilation of modern makeup units within the shortest deadlines and primarily of electric drives and numerical program control systems. Some licenses can possibly be purchased to accelerate the work. Modern machines can be made without new construction of machine tool plants, although perhaps in insufficient quantities. Only the simplest machines can be produced without modern makeup units. And this means that the gap between the level of Soviet machine tools and worldwide machine tools will increase with all the ensuing consequences. This tendency must be broken.

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## METALWORKING EQUIPMENT

### EXPERIENCE OF OPERATING MACHINE TOOLS WITH NUMERICAL PROGRAM CONTROL

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 1, Jan 82 (signed to press 14 Dec 81) pp 107-109

[Article by V. Ya. Maksimov, chief of production department for programmed machining, Ivanovo Machine Tool Building Association]

[Text] The use of equipment with programmed control essentially differs in our association from the approach to its operation at other enterprises. An independent complex service directly subordinate to the chief engineer rather than sections of machine tools with ChPU [numerical program control] in machine shops, groups or offices in the chief technician's department and others for resolving engineering and repair problems is present in which all production servicing subdivisions related to machining of parts according to program are combined.

Concentration and centralization of the entire stock of equipment with program control and of all functions of maintaining it in the same subdivision showed its advantages during six years of operation of the programmed machining production department (TOPO). Of the total number of 873 units of metalworking equipment at the pilot plant, 130 machine tools with ChPU and machining centers have been installed in the TOPO. Almost half of them have been made into an association. Comprising approximately one-fourth of the machine tool stock, equipment with ChPU performs more than half of the machining of parts. With regard to lathe operations, machine tools with ChPU take on themselves four-fifths of the program since it is becoming ever more difficult each year to find lathe operators for general-purpose machine tools.

TOPO has one of the highest equipment turnovers in the country--1.86. We have stable two-shift operating conditions and three-shift for some machines. There is only two-shift operation in the summer due to sensitivity of electronic systems, especially of Soviet manufacture, to overheating.

TOPO combines more than 500 persons--274 basic workers, 62 auxiliary and 180 engineering and technical personnel and salaried employees (electronic technicians, programmers, tool designers, line personnel and so on). The department chief has three deputies--for technological preparation of production, for production and for operation.

Three production offices--the rotary body office (in other words, preparation of production for machining parts on turning lathes), flat and housing parts office (preparation of production for machining on drilling-cutting and boring tools) and a tool support office--are subordinate to the deputy chief for technological preparation of production. There is a computer equipment group. The main specialists of these offices are programmer technicians. Their functions are to develop the technology, control programs and debugging of machine tools.

The deputy for production manages three production sections--rotary body (two sections) and flat and housing parts, headed by the chiefs of section and shift foreman. Organization of labor in the sections is only brigade type. An independent brigade leader is at the head of each brigade. We have no division into adjusters and operators. Machine tool operators perform both functions. Because of this they have a better knowledge of the equipment and have higher qualifications. They receive a supplementary wage for combining jobs.

Tool support of production is of important significance. Compared to other plants of Minstankoprom known to me, our machine tools are better supplied with fittings, tools and accessories, the cost of which comprises 30 percent of the cost of the basic funds of TOPO.

The office of ChPU system adjustment, repair office and transport office (electric carts, cranes and so on) are subordinate to the deputy for operation. Organization and payment of labor in maintenance and repair is also brigade type. The wage system is time-bonus type with issuance of a standardized task. Moreover, our brigades are complex type. They contain specialists in hydraulics, mechanics, electronics and pneumatics. The payment for labor stimulates learning the related occupations and the interchangeability of workers. Yet another characteristic feature of wages is that we are given incentives not by the volume of repair work performed but fulfillment of the planned time fund of equipment operation. The repairman receives the highest percentage of the bonus--60 percent of the established rate, if the machine tools operate, but he is not required that they operate. Undoubtedly, this situation can be achieved with ideal preventive maintenance of machine tools.

Control of the idle time of equipment is maintained by means of the Timing System, designed and manufactured by our engineers. Each machine tool operator has a device for summoning the required service which is equipped with a button control system and signal codes for the causes of idle times: "absence of blanks," "electronics," "mechanics" and "tools." There are illuminated indicator boards on which a lamp lights up upon the arrival of a malfunction signal and the idle time begins to be counted automatically. The indicator board in my office emits a signal about all types of idle times. The idle time is recorded until the malfunction is corrected. Errors are sometimes (very rarely) possible. A ring-off is then given and the signal is tched to another office.

It would be considerably more complicated to organize maintenance if the specialists were subordinate to different general plant departments--the chief

mechanic, chief power engineer and so on. Actually, that's the way it was previously. It was sometimes necessary to appeal to the chief engineer or director and the equipment idle times were considerably longer. After all functions related to operation and repair of equipment with ChPU were transferred to TOPO, only two cases occurred when I had to punish electronic workers and mechanics for inattentive analysis of malfunctions and untimely implementation of repair measures.

The incentives of engineering and technical personnel are also related to the time budget of equipment operation. The main condition for awarding bonuses to the engineering and technical personnel of TOPO is of course fulfillment of the plan by the department in the volume of production and nomenclature, labor productivity and product quality and assimilation of new parts. But the size of the bonus (maximum of 30 percent of the salary) depends on observing the planned stock of idle times--no more than 6 percent of the total balance of time for electronics, 3 percent for mechanics and 2.9 percent for production support, software and tool support. This norm was established by a set of statistical data over a number of years. It is now considerably more rigid than previously (idle time up to 15 percent was permitted in electronics).

We are now supplementing the TAKT idle time accounting system with accounting for new machine time of machine tool operation. To do this, sensors connected to the main motor and spindle of the machine tool are being installed.

Organization of the TOPO and use of machining centers permits successful implementation of the principle of maximum concentration of operations. Operational management of production is sharply simplified and facilitated. It is no accident that the production chief is trying to pass more parts through TOPO. He is providing blanks to the department and monitoring the emergence of finished parts. He is relieved of all cares on transfer of parts from machine tool to machine tool and from one machine section to another, with which production-dispatcher services are usually burdened.

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## METALWORKING EQUIPMENT

### MACHINE TOOL REQUIREMENTS AT VOLGA AUTOMOTIVE PLANT

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[Article by L. N. Pronin, deputy chief engineer for machine assembly production, Volga Automotive Plant, and A. Ya. Gil'buykh, deputy chief, chief mechanic administration, Volga Automotive Plant, Togliatti]

[Text] We have a rather clear idea of how complicated it is for machine tool building to operate and what an enormous number of customers with the most diverse requests it must service. And even so there are general principle requirements of equipment deliveries, fulfillment of which we feel is necessary. I would like to talk about them from positions of the most benevolent customer.

The efficiency and reliability of equipment is the first necessary condition for the mass flow-line production to which the Volga Automotive Plant belongs.

Many plants, in order to guard against accidents, keep duplicate equipment in reserve. This is a great waste as is maintenance of repair subdivisions in these shops. Our non-duplicate machining production lines are strictly designed for the rhythm of the main conveyor and the repair-operating maintenance system is centralized and subordinate to tasks of stable production support.

In mass production the quality of an article is determined by the quality and precision of equipment since quality depends to a decisive degree on the given technology and equipment at the level of automation and at the high tempo at which the production-flow lines of VAZ [Volga Automotive Plant] operate (an automobile is produced every 20 seconds).

The significance of the problem forced us to seek principle ways of solving it. Unified requirements on equipment deliveries were formulated during development of VAZ. They were based on a number of principles which were taken into account in operation of European machine building enterprises. The general specifications (OTU) of VAZ, as we called them, were sent to all equipment suppliers both in our country and abroad. The requirements of the OTU were higher in some items than in Soviet standards. What are the OTU? A few words about the main points.

First, requirements on precision were formulated. The precision norms developed by the Austrian professor Schlezingner were taken as the basis.

Second, requirements on the quality of the makeup units--hydraulics, electrical systems and automatics, which in the final analysis determine the reliability and efficiency of automatic lines, were outlined. We insisted on delivery of equipment with import makeup units of several companies that had recommended themselves well. This was important to us for two reasons: a) since two-thirds of VAZ equipment was purchased by import, the makeup of the electrical and hydraulic systems of Soviet machine tools was desirable by the same supplier companies so that maintenance of them could be standardized and b) the reliability of Soviet makeup units was not yet sufficiently high. We are now convinced of this not only as customers of foreign machine tools but as manufacturers of our own machine tool products (a number of special types of equipment is manufactured in VAZ's own machine tool building production). Before beginning assembly of hydraulic equipment and electrical systems obtained for it through cooperation, we inspect them, wash them, remove excess oil, remove burrs and so on. All this is perhaps minor finishing items, but nevertheless you can't get along without it if precise and reliable equipment is to be produced.

Of course, the requirements in makeup units in import deliveries are not constant and these requirements will drop in time when we in the Soviet Union have sufficiently high quality of the electrical equipment system, electronics and hydraulics for machine tools. But the principle of high reliability and efficiency of makeup units and standardization of systems for ease of maintenance remains one of the main and most important principles. The responsibility of the coexecutors of Minstankoprom [Ministry of the Machine Tool and Tool Building Industry]--Minelektrotekhprom [Ministry of the Electrical Equipment Industry], Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems], Minelektronprom [Ministry of the Electronics Industry] and other sectors--for makeup of machine tools should be raised.

Third, we have provided for final turnover of equipment at the customer plant, unlike the system adopted at Minstankoprom of inviting customers to the supplier plant and there to operate the machine in manufacture of several parts. The installation chief and company service have long become an indispensable operating condition of equipment manufacturing enterprises in worldwide practice. Orientation toward the customer is a progressive principle of business cooperation and it should be developed in our system of production relationships. The decisions of the 25th and 26th CPSU Congresses posed this problem.

Fourth, equipment must be delivered in a complete set with tools and accessories, which is also atypical for Minstankoprom. This condition was vitally necessary at VAZ at the time it was started up. After all, all shops were constructed simultaneously--both the main and auxiliary shops, including the tool shops. We could not support ourselves with tools; therefore, we insisted on deliveries of tools together with equipment designed for 1,000 hours of operation. We feel that this item is both a principally important and necessary one now for any enterprise. Whereas manufacture of all types of tools is

expensive and difficult even under the conditions of such large production complexes as VAZ, KAMAZ [Kama Automotive Plant], ZIL [Moscow Automotive Plant imeni I. A. Likhachev] or GAZ [Gor'kiy Automotive Plant], then this is sometimes beyond the capability of small and medium enterprises.

Delivery of equipment according to general specifications was among other items confirmed by a government decree on construction of VAZ. Imported equipment was purchased for the first and second units of the plant and Soviet equipment, made according to this OTU, was purchased for the third unit. A sufficient number of years has now passed in order to make convincing comparisons and to make conclusions. The delivery equipment of the third unit hardly differed from that purchased abroad.

And now seven years after start-up of the first unit of the plant, it has now become necessary to purchase equipment, this time with regard to the fact that we have organized production of the VAZ-2121 automobile, known under the name Niva. We have again attempted to apply general specifications. But this time many enterprises have not accepted them. They said to us: "If you want them take the machine tools manufactured according to our individual specifications. We cannot offer other equipment."

Since the purchases proceeded on common bases, we had no recourse than to abandon our own OTU when ordering machine tools. But we had no intention of abandoning the level of technology and quality adopted at VAZ. The honor of the trademark and fulfillment of warranties given to the customer forced us to seek other methods of ensuring the quality and reliability of the automobile being developed. Roundabout versions of the production process using general-purpose equipment were required in manufacture of some parts. Since this is inefficient and troublesome in mass production, it was understandable to everyone, even those who were not a machine builder.

Thus, in the Niva manufacturing building, we received a second copy of the equipment produced according to the specifications of the manufacturing plants. Whereas organization of the production lines of the first three units delivered as a complete set according to the OTU of VAZ made it possible to reach design capacity rapidly (one third the capacity was achieved in a year--production of 220,000 Zhiguli automobiles, the design indicators that provide for production of 660,000 automobiles were completely reached within three years), reaching the capacities for 50,000 Niva automobiles was drawn out to three years. The level of the equipment of the second delivery was of a different cloth--it reflected the specifications of the manufacturing plants.

It is typical that there are enterprises which, having adopted our OTU in 1972, made a number of design changes in the equipment and emerged to the worldwide level in both its reliability and precision. For example, the Khar'kov plant imeni Kosior provided us with circular grinding machines. Therefore, the machine tools acquired from it for the Niva building were essentially at the same level as the grinding equipment of the first unit purchased from the Normon Company.

The lesson of Niva was not lost on us. In 1980, beginning preparation for production of a new model of the VAZ-2108, taught by bitter experience, we

decided to firmly uphold our general specifications. We accumulated sufficient statistical data over a period of 10 years on the operation of the equipment and we could familiarize interested organizations with them--Quality Control Inspectorate of Minstankoprom, Gosstandart and ENIIMS [Experimental Scientific Research Institute of Metal Cutting Machine Tools]. These data rather clearly show the difference in operation of the equipment of the first and second deliveries.

ENIIMS did not maintain our requirements and they were turned over to Gosstandart for judgment. They were very understanding in these requirements there. Some of them were introduced into GOST [State Standards] and specifications and became compulsory for all machine tool building plants in all cases of supporting deliverers. These are primarily requirements on precision. On the whole, the general engineering requirements of VAZ on equipment are not accepted by Minstankoprom for the 2108 model.

Among those specifications that they rejected, we feel that the essentially important ones are requirements of turnover of the machine tool to the customer. Legally this item seems to hardly differ from the edition which Minstankoprom proposes--signing an agreement for turnover and an installation chief. But the ministry has in mind turnover of a machine tool upon machining of representative parts (the most typical ones for the customer) at the manufacturing plant and an installation chief at the customer with the equipment operating in idle. We insist on an installation chief and turnover of the machine tool at the customer's in machining a specific part with statistical control of dimensions rather than at idle.

The impression is created that Minstankoprom generally does not plan to become involved in the company service problem. It is impossible to invite a plant representative upon malfunctions of operating equipment--the machine tool is turned over and you operate it as you like. Some enterprises do not send their own specialists even for the installation chief. A heavy planomilling machine from Minsk that has not been put into production has been standing idle at our plant for two years. A pleasant exception is the jig-boring machines. A clear system of maintenance performed by the network of enterprises of VPO [All-Union Production Association] Remtochstanok has been worked out for them.

Of course, it is impossible to reduce everything only to the lack of desire of machine tool building enterprises to meet the requirements of customers. A lack of economic interest stands behind this. We underpay by 5 percent to foreign companies upon delivery of equipment. And we settle our accounts fully only after it has been turned over at our plant in operating condition. We pay the enterprises of Minstankoprom fully at once for their products. Therefore, they are unwilling to finish it. They have no intention of increasing labor expenditures.

The economic mechanism of the relationships of manufacturers and customers of equipment must be improved. This is a real problem for all machine building.

Our specifications were also not accepted on delivery of equipment in a complete set with tools and accessories for 1,000 hours of operation and of



supplying spare parts for the equipment for 10,000 hours of operation. At our rates of continuous two-shift operation of equipment, 10,000 hours is not so much--2.5 years. And it turns out with the proposed specifications of Minstankoprom that we must immediately begin thinking about manufacture of spare parts for it immediately upon receipt of the equipment. In 1980 spare parts worth 10 million rubles were manufactured at VAZ for repair-operating needs and in 1981 11.2 million rubles' worth were manufactured.

Foreign companies sell as many spare parts as needed. And the price is controlled there. Spare parts and parts which are packed up and delivered together with the equipment are sold at one price and if they are delivered separately they are sold at another price. Moreover, they are more expensive by a specific percentage with each following year after production of the machine. The manufacturer then does not bear a loss in their production and he has no loss in producing spare parts for articles which have already been taken out of production.

The output of spare parts should also be regulated by means of the economic mechanism. But Minstankoprom should first create a legal position on manufacture of spare parts would regulate the legal aspect of the activity of all enterprises of the sector in solving this problem.

The following task is posed in the "Basic Directions for Economic and Social Development of the USSR for the Period 1981-1985 and for the Period Up to 1990": "Provide delivery of complete sets of equipment of high plant readiness according to the customers' requirements and starting-adjusting operation and turnover of this equipment to customers by machine building enterprises and associations." Fulfillment of this task depends on the extent to which the regulating propositions and instructions of Gosstandart, legal questions and the economic mechanism of equipment deliveries are tied in.

Now a few words about our production requirements on special equipment. Automatic lines and automatic machine tools should have a minimum number of maintenance personnel. To do this, the maximum concentration of operations must be provided in their designs. Little automatic equipment is now produced, maintenance of which is related to a large number of manual operations. Thus, we should maintain a prefinishing section with general-purpose equipment in which drilling and milling of parts machined on these automatic machines are carried out for the automatic lathes of the Kiev, Moscow and Zhitomir plants. The most unpleasant position is the Emery section where manual cleaning must be done after automatic machining of parts. A number of accessories that completely eliminate prefinishing operations have been provided in our similar imported equipment.

The machine tool builders are especially unwilling to become involved in the problem of combining automatic machining of parts to automatic loading and unloading. Each plant begins to develop loading devices through its own efforts. Moreover, production of them could be organized on scales of the entire sector of Minstankoprom and could be standardized for ease of operation.

Problems of transport tie-in of automatic equipment, combining operations by building some machine tools into an automatic line, for example, boring or broaching machines, are related to this problem. Western companies develop special models of machine tools designed for being built into production-flow lines. This trend has not yet been developed in the Soviet Union. For example, the Moscow Automatic Production Line Plant does not make any boring machine tools and does not build them into lines. We must become involved in this ourselves.

The machine tool building plants have demonstrated that they can do much if required. The Yeysk Plant made two machine tools for us in 1970 for manufacture of camshafts. They were outfitted with everything required: both automatic loading and unloading devices and transport links. The plant manufactured a third section eight years later but without any additional devices at all. We made them ourselves. The entire paradox is that the Krasnodar Design Office (SKB AI), which is a developer of machine tools for the Yeysk Plant, designed these devices for us. And as the Khar'kov workers began producing grinding machine tools with automatic loading, they continued to do so even today.

It is better to pay more for outfitted equipment than to have people involved in heavy manual operations. Every additional person is not only a surplus of workers who are now so expensive, but also an additional apartment, wage, kindergartens and much more. Automation is not only an economic but an important social problem as well.

Adjustment of tools outside the machine tool. There is a definite standard for it on the European scale. It provides that the equipment manufacturers outfit machine tools with special tool cabinets and accessories for adjustment. If a tool must be replaced, it is sufficient to remove one unit from the machine tool and to insert another, adjusted by means of these special devices.

We have included these accessories to equipment in our OTU. Some of our suppliers have accepted this condition and provide us with accessories for adjustment. We develop them through our own efforts for the remaining equipment. We cannot operate without them. This would be equivalent to increasing the production areas, number of operators and adjusters and acquiring additional equipment.

The problem of devices for adjustment is timely for all automatic equipment and for machine tools with ChPU [Numerical program control]. To fool around with adjustment when an expensive machine is standing idle is an unforgivable sin! This problem must be solved on the scale of the entire machine tool building sector. Centralized production of accessories for adjustment outside the machine tool, and standardized ones at that which could be used with any equipment, must be organized.

After all the foregoing it is more understandable why we must develop our own machine tool building. We manufacture nonstandard equipment, special machine tools, transport systems and automatic parts loading and unloading devices. But besides this we sometimes are forced to produce automatic lines and

machine tools similar to those produced by Minstankprom. This happens when this sector refuses to deliver them within the deadlines required by us.

We are manufacturing through our own efforts a large number of assembly machine tools and washing machines since no one produces them on a centralized basis. For this reason we are producing much casting equipment, for example, for removable-flask molding. And we are making facing lathes for the entire automotive industry. Some design solutions for these machine tools have been patented. Because of our production, the sectors have managed to reject imports of these machine tools and to save 500,000 foreign currency rubles annually.

We have been faced recently with yet another problem--the use of machine tools with numerical program control. The fact is that each new automobile, before going onto the flow line, goes through a series of checks and tests. Only then is the model confirmed and special production equipment is ordered for it. We decided at VAZ to expand the scales of this work and besides the experimental shop managed by the chief designer, to develop a small-series shop to produce 300 automobiles annually. And this is quite a different type of production. The small-series shop will be the instance where each new model will undergo testing and experimental checking with high reliability. It has been decided to equip this shop with machine tools which ChPU.

Turning to equipment with program control, we are guided by the following concepts:

- to reduce the laboriousness of manufacturing small-series automobiles within 3-4 years compared to the first models made in an experimental shop on general-purpose machine tools;

- to have high machining precision and at the same time not to depend on worker qualifications.

Being involved in machine tools with ChPU, we have encountered difficulties which we did not suspect earlier: the different systems nature of programmed devices and the shortage of engineering and programmer personnel. They are trained, insofar as we have been able to establish, only by the Tomsk Polytechnical Institute. It is even more complicated to acquire spare parts, for example, ball screw pairs for machine tools with ChPU.

Soviet machine tools with ChPU are delivered as general-purpose types--without tools and accessories. Only the Krasnyy Prolet'ariy Plant produces 30 unsharpened plates and 5-6 holders. We had to mainly make the tool equipment for machine tools with ChPU and for all the special metalworking equipment ourselves. We have our own standards for cutting and auxiliary tools that are stricter than those at specialized tool plants. We use extensively multisided unsharpened hard-alloy plates with mechanical attachment instead of soldered cutters. A system for standardized attachment of cutting tools has been developed at VAZ for machine tools with ChPU. It can be used with any model of this type of equipment.

The stability of the tool and the cutting speed are of enormous significance for efficient use of automatic equipment and programmed machine tools. There are operations where hard alloy cutters are inadequate and the use of a tool made from synthetic superhard materials becomes even more necessary, for example, when machining brake drums, flywheels and some other parts. Hard-alloy tools permit machining of 2,000 parts without replacement and synthetic diamond tools permit machining of 45,000 parts. What a different order of figures! We constantly feel the shortage of tools based on superhard synthetic materials. Minstankoprom is very slowly developing capacities to produce these most promising tools. There are no other sources of obtaining them in the country.

Thus, these are the main problems which VAZ encounters in operation and repair of metalworking equipment. In ending my talk about them, I must again turn to problems of planning and management. The desire to produce volumes and to provide the planned increase of machine tool production in units forces enterprises to avoid excessive labor expenditures, without which the production capabilities of equipment could not be increased. Hence, its low level of being equipped with automatic loading devices and transport links, accessories for adjustment, tools and so on.

One trait is indicated in the relationships of machine tool building and customers about the imperfection of economic management of development of new equipment. Customers, upon ordering the equipment, should offer calculations about the effectiveness of introducing it. Our calculations very frequently do not satisfy Minstankoprom, since we compare the equipment being ordered to that which we had earlier--what we obtained for the first imported units or from our own general specifications. To the extent that the manufacturing plants do not accept many of the OTU conditions, the equipment that they manufacture for us will be lower in level and its economic effect has a minus sign. Minstankoprom suggests comparison with the baseline model, that is, to a general-purpose machine tool. We don't even have any concepts about this simplest equipment, the great grandparent of our special machine tool or automatic line. The machine tool builders then make calculations themselves. And we are supposed to sign it! They drive us into a corner: if you don't sign it you won't receive the machine tool.

Tasks for increasing the output of progressive equipment with numerical program control, automatic lines and complexes, equipment production corresponding to specific operating conditions in different sectors of the national economy and regions of the country are posed in the "Basic directions for economic and social development of the USSR for the period 1981-1985 and for the period up to 1990." And this means that machine tool building must intensify its orientation toward the requests of the customer. Specific principles and conditions for equipment deliveries are required.

We feel that many items of the VAZ general specifications can be used in development of these unified conditions. Specifically, the requirements on precision norms and the level of makeup units, conditions for turnover of a machine tool to the customer, conditions of supply with spare parts and outfitting with tools and accessories for adjustment of it. The legal unity of



requirements on equipment deliveries permits all machine tool building enterprises to be on equal conditions with respect to customers.

The legal and technical requirements on equipment should be reinforced by economic measures of incentives for improving it in planning, pricing, payment for company service and spare parts production.

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## METALWORKING EQUIPMENT

### IMPROVE TOOLS AS NEEDS INCREASE

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 1, Jan 82 (signed to press 14 Dec 81) pp 119-125

[Article by Candidate of Technical Sciences D. I. Semenchenko, deputy director for scientific work, All-Union Scientific Research Institute of Tools, Moscow]

[Text] It has been historically established that Soviet tool production is mainly decentralized in nature. During industrialization the country was faced with the task of concentrating attention on development of Soviet machine building. It was solved successfully. However, priority use of capital expenditures to develop equipment production, including machine tool building equipment, was reflected to a specific degree in rates of development of tool production, which were lower than in machine tool building, and in the specifics of its organization.

One-third of the tools now produced in the country are manufactured at specialized enterprises of the Ministry of the Machine Tool and Tool Building Industry and two-thirds are manufactured in the tool shops of enterprises of different sectors.

Is this good or bad? There is no clear answer to this question. Specialized tool plants of Minstankoprom [Ministry of Machine Tool and Tool Building Industry] make standard tools of good quality and sufficiently low cost. The other part of tool production, concentration in the tool shops of many sectors, is nonuniform. On the one hand, large tool shops of machine building enterprises provided with highly qualified personnel and modern equipment produce high-quality articles. A trend is noted here to centralize and specialize tool production on the sector scale, as has already been done in the Ministry of Tractor and Agricultural Machine Building. The chief of the VPO [All-Union Production Association] Soyuzpromtekhnomatizatsiya V. P. Yefimenko\* told at EKO [EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA] about how there are several specialized tool plants in the VPO and the remaining production is included in associations in the form of plants or shops converted to centralized planning. On the other hand, there are many small tool shops at enterprises of many sectors that manufacture tools, imperfect in quality and design, with high specific expenditures.

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\* See EKO, No 10, 1979, for broader aspects.

Therefore, the following tasks are quite obvious: first, accelerate the rates of development of the specialized tool sector and second release small inefficient tool shops while retaining large shops. They are especially timely now with regard to the problem of providing modern metal cutting equipment with tools: machining centers and machine tools with numerical program control, automatic and semiautomatic machines, automatic lines and so on.

Organization of producing a standard set of cutting tools for machine tools with ChPU [Numerical program control], but in very limited nomenclature and very small numbers, was begun at the Orsha, Tbilisi and Khar'kov tool plants during the 10th Five-Year Plan when the scales of production of these machine tools were increased. These enterprises can satisfy the needs of machine tool builders only to an insignificant degree.

Such a new problem as manufacture of auxiliary tools to strengthen the cutting tools on machine tools with ChPU, including those on multitool machines of the "machining center" type, arose during this period. The Riga Experimental Production Equipment Plant and the Kalinin Die Plant, VPO Soyuzosnastka, were perhaps somewhat better prepared than others to solve these problems. But first, they will be able to satisfy only minimum needs and second to take on themselves of only several types of tools.

Auxiliary tools for machines with numerical program control are now manufactured by the machine tool plants themselves. They must recruit personnel from the output of basic products to do this and they must seek out additional areas and capacities which these enterprises do not have available.

Both directions--production of cutting and auxiliary tools for equipment with program control--are needed in accelerated development. In this regard it is impossible to take into account the rates of reconstruction and re-equipping of existing plants and development of new capacities designed for these types of tools.

The next important problem related to improving the structure of the machine tool stock is expansion of the tool nomenclature of a higher technical level, increasing its resistance and strength and increasing the operating life.

Solid alloy cutters with mechanical attachment of multisided unresharpened plates (MNP) find wide application in worldwide practice. If one side becomes dull, one only has to turn the plate and one can continue to machine parts. This is of especially important significance when operating such expensive equipment as machine tools with ChPU and machining centers.

Multisided unresharpened plates are not only distinguished by operating convenience, but also permit one to return up to 90 percent of the solid alloy mass for secondary extraction of scarce tungsten. Therefore, our task during the next few years is to reduce the output of cutting tools and milling cutters with soldered hard alloy plates and to increase the production of tools with mechanical attachment of MNP.

Our institute began work as early as 1960 to develop tools from hard alloys with mechanical attachment of the cutting part. Twenty years have passed. Unfortunately, production of tools is not being developed at the rates that are required. Much time was lost on forcing the manufacturers of hard alloys (enterprises of Mintsvetmet [Ministry of Nonferrous Metallurgy]) to provide us with the required plates. When we began to become involved in this problem 20 years ago, the engineering level of plates was satisfactory. The precision requirements on the plates then increased. Foreign manufacturers knew how to increase the quality of plates, while the quality of ours remained as previously.

To do justice, it should be said that Minstankoprom is not supplying nonferrous metallurgy with the machine tools required to machine these plates. VAZ [Volga Automotive Plant], KamAZ [Kama Automotive Plant] and some aviation plants have transferred part of their foreign currency funds to Mintsvetmet to purchase equipment to produce hard alloy plates. Apparently, nonferrous metallurgy is primarily supplying them. The tool plants of the specialized sector, according to our analysis, are receiving one-fifth the MNP required.

The majority of hard alloy tools is produced with welded-on cutting edge. It must be constantly resharpened, due to which cracks form and accuracy is lost. We have proposed cooperation with nonferrous metallurgy in solving the problem of more efficient design of hard alloy tools, but we have received no response.

Hard alloys for tools are produced in worldwide practice at the same plants where they are manufactured. Therefore, there is the capability of greater flexibility and greater maneuverability in organization of production. Being subordinate to the tool makers, hard alloy production is adjusted as required at a given moment. Our problem is artificially divided. There are scientific subdivisions and several hard alloy combines (the best of which is the Moscow Combine). We are involved in problems of designing tools from hard alloys and in the techniques of using them in metal working. We feel that it is more feasible to concentrate the hard alloy manufacturing plants in the same agency with tool plants.

The main tool material continues to be high-speed steel, the fraction of which is up to 68 percent of manufactured tools. And as a whole the structure of the materials used in tool production appears as follows: 68 percent to high-speed steel, 20 percent to hard alloys, 8 percent to carbon steel (it is long past time to stop using carbon steel due to its insufficient life and productivity. However, use of it during the past few years has even begun to increase with regard to the shortage of high-speed steel) and 4 percent to cement plates and superhard materials produced on the basis of artificial synthesis.

One of the most promising is production of tools from superhard synthetic materials: polycrystalline diamonds and boron nitride. Our institute is working jointly with the Institute of High-Pressure Physics and the Institute of Hard Alloy Physics, USSR Academy of Sciences, Institutes of Superhard Materials and Problems of Materials Science, Ukrainian SSR Academy of Sciences,



and a number of sector institutes on this problem. It is capable of processing those materials with which neither hard alloy cutters nor high-speed steel have been able to cope: rough sulphur and chilled cast iron, steel of any hardness and hard alloys. In this case the machining surface competes with grinding and is free in many cases of finishing operations. The time advantage is 3-6 times greater compared to cutting with hard alloys.

Tools made from superhard materials are competitive on the foreign market. Our institute has sold three licenses for the technology of machining with milling cutters and cutting tools from a composite based on boron nitride.

Output of this highly efficient tool has been organized at a number of plants of Minstankoprom at Moscow, Leningrad, Poltava and Yerevan. Its production increased tenfold during the Ninth Five-Year Plan compared to the Eighth Five-Year Plan and increased threefold during the 10th Five-Year Plan compared to the Ninth Five-Year Plan. It is planned to increase production another 1.5 times during the 11th Five-Year Plan. The rates seem to be impressive but they are still insufficient. The limited capabilities of equipment to design plates from superhard synthetic materials are being hindered, although progress in this direction has been noted recently. An installation for automatic synthesis of synthetic materials (ASIM) has been created at VNIImalmaz [expansion unknown]. Nine installations are already in operation at the abrasives plant. Whereas an operator serviced 2-3 installations previously in synthesis of synthetic diamonds, he can service 15 after introduction after introduction of ASIM and tool quality is being increased.

Another modern direction of tool production--manufacture of milling cutters from ceramic-mineral plates--is also being slowly developed. In 1952-1954, when mineral ceramics had only begun to be used in cutting metals, our country occupied the leading position in the world in development of this technology. At that time production of ceramic-mineral plates was organized at the Moscow Hard Alloy Combine. The ceramic cutters had one deficiency: they were too brittle. Therefore, despite the considerable increase of the speeds of machining metals when using ceramics even compared to hard alloys (twofold or more), machine tool operators soon lost their taste for this tool. Instead of finding ways to increase the life of mineral-ceramics, they all became cool to it--the developer institutes, manufacturers and consumers. They returned to this problem 20 years later due to the initiative of VAZ specialists. Along with some other production processes of the Fiat Company, machining of parts from high-strength cast iron with cutters and mineral-ceramic plates arrived at the Volga Automotive Plant. If the VAZ workers had replaced this technology with cutting with hard alloy plates, they would have been forced to deliver two or three times more metalworking machine tools in these operations. To the credit of the specialists at the automotive plant, they were in the leading positions here and insisted on the use of mineral-ceramics. The scientific subdivisions which were developing the composition of mineral-ceramics then had to return to the problem (enterprises of Mintsvetmet manufacture mineral-ceramic plates). The problem of producing a stronger composition was posed. The technology of hot molding of ceramic plates is being developed. A total of 500,000-600,000 plates is being manufactured in the country annually and 10 million units are needed. By 1985 it will increase to 15 million units annually.

Expansion of industrial production and the use of mineral-ceramic plates will make it possible not only to save hard alloys but to increase labor productivity in metalworking 1.5-2-fold compared to them.

A large reserve to meet the need for tools is their proper operation. Checks of 100 plants of different sectors of industry, made by Orgpriminstrument [Expansion unknown] at our scientific research institute, showed that the labor productivity of machine tool operators can be increased by 3-5 percent by increasing the technical level of tool operation. A technical inspection service of tool operation, similar to the departments of tool analysis of VAZ, can be organized at machine building and machine tool building plants.

Problems of tool production require operational solution since further development of machine tool building and machine building largely depends on this. An intersector complex program is required in which all of the most important aspects of the problem would be taken into account--material support, the level of technical equipping and prospects for use of new technologies, development of capacities and their reconstruction and personnel training.

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## METALWORKING EQUIPMENT

### GOSPLAN: PLANNING WITH OPEN EYES

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 1, Jan 82 (signed to press 14 Dec 81) pp 125-135

[Interview with chief of machine tool building department, USSR Gosplan, L. N. Snovskiy, by special EKO correspondent I. Ognev]

[Text] [Question] Lev Nikolayevich, permit me to begin with questions related to the machine tool stock, its size and structure. The "roundtable" participants persistently said that it is impossible to expand the stock more and that the rates of renovation should be increased.

[Answer] I will say immediately that it is planned to reduce somewhat the output of machine tools (from 200,000 to 170,000-180,000 units annually) and simultaneously to accelerate renovation of the stock by a factor of 1.2 during the 11th Five-Year Plan compared to the 10th Five-Year Plan. But in order for this maneuver to succeed it is necessary that new machine tools be a minimum of 1.5-fold higher in productivity compared to those produced during the 10th Five-Year Plan.

[Question] This means that the deadlines for assimilation of new types of equipment must be reduced sharply.

[Answer] Of course! But this is one aspect of the matter. Another is that we presently have an inadequate knowledge of our own machine tool stock in the country. We frequently compare it to the machine tool stock of different countries. But do we talk about whether things are comparable? For example, machine tools costing up to \$1,000 are highly regarded in the United States. These are small machine tools. It is clear that you can't get along without them as a home cannot get along without scissors. Different types of sharpeners and bench drills are also required by both the rural forge, the school and the vocational-technical school, but it is also clear that this equipment is auxiliary and does not determine scientific and technical progress. How many machine tools are in its stock? What is its fraction? We find this out from the list of equipment produced at the beginning of 1981. We analyze its results and we make the corresponding conclusions from this.

It is frequently said that the stock is large and there are not enough machine tool operators. In fact no one knows how many there are. A person is

sometimes called an operator due to incomplete rate schedules. We are awaiting refinement of these data as well from the inventory.

[Question] And how did the output structure look during the previous five-year plan?

[Answer] There were serious structural changes in the overall reduction of machine tool output, especially those with manual control, during the 10th Five-Year Plan. The output of special machine tools was increased by 37 percent and output of machine tools with ChPU was increased by 60 percent, but the fraction of general-purpose machine tools and those with manual control is still high. The task posed by the decisions of the party is to increase the fraction of progressive machines. They are being produced by 25-30 plants--the Gor'kiy, Ivanovo, Ryazan', Leningrad, Moscow and others. We are now seeking ways of how to increase the production of these machine tools there. We are also thinking how the plants that produce simple machine tools, without which one cannot get along, can be specialized. Of course, they are unable to convert immediately to complex machines, but why could they not make assemblies and parts on a cooperative basis for plants producing progressive equipment?

[Question] This means that these changes are planned for the current five-year plan.

[Answer] Machine tool building will be developed during this period at accelerated rates. Capital investments will be increased more than twofold. But it will not be possible to completely return these funds during the 11th Five-Year Plan. After all, machine tool building has recently been developed at slower rates than machine building as a whole and this cannot help but have an effect. For example, 7-8 years ago we almost never purchased heavy machine tools but on the contrary sold a good many of them. Exports have now been significantly reduced but we have a serious shortage in a number of models.

[Question] How did this situation develop?

[Answer] Because we did not respond in time to the process which was planned in different areas of technology, including the increase of the unit capacities of machines, assemblies and production units. Quite different equipment was required to manufacture them. The highest volumes of capital investments are now directed toward these goals but we will receive a return within 10 years.

But this is equipment for unit production and mass production as well. VAZ, AILF [expansion unknown], ZIL [Moscow Automotive Plant imeni I. A. Likhachev] and other automotive and transport plants should either change their products or should expand. To do this, they need a considerable amount of automatic production lines. This means that new additional capacities are needed in special and unit machine tools and automatic production lines. Substantial capital investments have also been allocated for this.



Finally, take small-series production. Its fraction is high in machine building. In order to switch rapidly from one type of equipment to another, a flexible technology using machine tools with ChPU, including machining centers, is required. It is planned to increase production of this equipment both by construction of new enterprises and by respecialization of existing enterprises and by reducing the production of general-purpose machine tools with manual control.

As you can see, a significant change of the equipment output structure is planned by decrees of directive organizations and by our plans. However, the ministries have presented more modest plans.

[Question] And what changes are planned in production of finishing equipment.

[Answer] You understand what the paradox is here. On the one hand, we have a specific weight of finishing equipment less than in industrially developed countries. So then, customers should flood us with requests to develop production of this equipment. But we do not feel any special insistence on their part, with the exception of such mass production sectors as truck-tractor. And on the contrary, there is a great demand for lathes, milling machines and other machine tools with manual control.

[Question] What is the cause of this indifference.

[Answer] Obviously, it is in the billets and insufficiently high level of production processes in plant plans. The more precise a blank is, the more or acute need there is for finishing equipment. And on the contrary, the less the blank approaches a part, the greater the weight of lathe, milling and other rough operations. You know that we cannot brag about the high utilization factor of metal in machine building as a whole and it is even lower in machine tool building. Moreover, the fraction of forge-press equipment in our machine tool stock is now the same as in the United States, while we make fewer precision blanks. Why is this? After all, there is a forge at any enterprise. But you take a look and you find ordinary hammers and few dies. This means that free forging predominates in which one does not avoid large allowances on the blank. I am no longer talking about the grade of metal, which also affects the amount of cuttings.

Of course, production of forge-press equipment must be developed which yields a precision blank, including those from metal powders.

[Question] What is planned for this during the 11th Five-Year Plan.

[Answer] Considerable efforts were undertaken even during the 10th Five-Year Plan. Compared to the Ninth Five-Year Plan, capital investments for these purposes and they will increase an additional twofold during the current five-year plan compared to the 10th. Undoubtedly, we will feel a return during this five-year plan, but no revolutionary changes will occur in the equipment structure. We will especially feel a shortage of precision equipment. Although, I repeat that it would not be correct to judge this only by demand. The demand for equipment is an insidious business. If one follows only it,

one can form such a stock. Here is yet another example for you--the demand for machining centers is much less than for the same general-purpose machine tools with manual control. This was the same situation several years ago with machine tools with ChPU. They frequently had to be imposed on plants.

[Question] How do you explain this conservatism.

[Answer] By the level of technologies. Sectors, with the exception of perhaps automotive builders, very timidly accept progressive proposals. First, they simply know little about them. Second, if they did know, they did not always hope to receive the corresponding equipment for these plans and the main thing, to receive it within the deadline. This is how technology is organized for which deliveries are guaranteed. And third, the machine tool builders themselves should form the demand for progressive technologies, but they are little involved in this. So production of a single article must be begun. The plan required a large number of general-purpose machine tools with manual control from the Leningrad and Ivanovo plants. It would essentially have to turn over the annual production of this model. We advised them to turn attention to the technology and travel to Ivanovo for consultation. As a result the plant got along with one-third or even one-fourth--I don't remember exactly--fewer machine tools.

The controversy is still not ended with equipment manufacturers for gas-pumping stations. They request nine 5-meter vertical turning lathes. We looked at the part--it is high, it has to be bored from inside in darkness. Why is this technology required? We suggested another--you can get along in the extreme case with two to four machine tools. I ask the chief engineer: Why drag this technology into the 21st century? He is silent. And incidentally, a 5-meter machine tool is required for three parts, while a 2-meter tool is required for the remaining parts. But they order the maximum amount of equipment for all situations.

[Question] The "roundtable" participants turned attention to this aspect. Investigations show that the size parameters of parts in machine building are increasing while those of machine tools will increase.

[Answer] Everyone is attempting to produce larger machine tools. For example, the Dmitrov Plant makes milling machines with table 250 mm wide, the Vilnius plant makes them 200 mm wide, while the Gor'kiy plant makes them 320-400 mm wide. The output at Dmitrov and Vilnius can now be reduced, while there is a great demand for Gor'kiy machine tools. There is also the matter of price. The Gor'kiy machine tool builders produce approximately 8,000 machines annually and of course they will be less expensive in this volume! But those plants have fewer but more expensive machine tools because they make 2,500 to 3,000 units annually.

On the other hand, let us see how the customer answers who has bought a less expensive machine, only in the percentage of payment for funds which he places in cost. I feel that the plant should achieve a standard following the machine tool: pay so many rubles of products with this machine. The plant

capacity is being determined by a bottleneck. Most frequently this is 20-30 machine tools operating in two and sometimes in three shifts. But the remaining 200 are not as loaded. But the director still doesn't do anything for his neighbor who does not have these machine tools. How then is cooperation to develop? Obviously, both economic and organizational levers are required. I have in mind territorial organizations which have specifically utilized the capabilities of cooperation.

[Question] If you do not object, Lev Nikolayevich, let us talk a little of how machine tool builders can influence formation of the production orientation of customers.

[Answer] At one time I suggested that a small group of 5-6 specialists, perhaps retirees, be created at Minstankoprom so that they could provide conclusions for all plans of machine building plants. What equipment should be included in the plan? How do they plan to utilize it? The ministry did not react to this.

[Question] But still there are sector expert councils.

[Answer] They do not interfere sufficiently in production policy and sometimes because of their inadequate knowledge. I understand that machine tool builders are unable to affect all machine building. But they should at least keep in mind the most fund-consuming scarce equipment. It is necessary here to deliver complete sets rather than individual machine tools. But how to accomplish this organizationally is a problem still to be worked on and this should be done as soon as possible.

I would like to turn special attention to the fact that it is incorrect to judge the need for requested demand--the requests of customers, as shown by experience, are hardly responsible. For example, it is unclear how many machine tools with ChPU and machining centers are required. There is a method but it is imprecise and it proceeds from the current status of the stock. Hence, there are also controversies specifically with the Ivanovo workers. Based on analysis of current and future progressive technologies, it is extremely important for institutes to determine the calculated needs. Gosplan will then plan properly. I think that the machine tool builders should take this serious when they actually satisfy the needs.

[Question] Lev Nikolayevich, one additional question troubles many. Approximately half the machine tool stock is outside machine building.

[Answer] This is not because of the good life. And it is explained by the fact that the machine builders do not always produce spare parts in sufficient quantities. Approximately half of the machine tool stock is outside machine building. The trend of machine tools to other than machine building was reduced sharply during the past few years. But the pressure on Gosplan is strong. Obviously, this line must be held even more rigidly. How is this so? Minrybkhos [Ministry of the Fish Industry] constructed a "box," capital investments were found under the pretext that there were not enough spare parts. The "box" must now be repaired with equipment. They come to request

"give it!" What? The usual general-purpose low-productive equipment. And the return of a machine tool is three times less here than in machine building. How will it be with agriculture? They also have norms: so many lathes and milling machines per 10, 50, 100 tractors or combines. The countryside collects much equipment but its return is several times less than that in machine building. I was interested in how many MTS [Machine and tractor station] there were at one time. There were approximately 10,000. All of them had spare parts warehouses. Since then more roads have been built, the entire infrastructure was improved and communications between kolkhozes and sovkhoses were more reliable. But the number of spare parts warehouses increased tenfold. Place one part each in each warehouse and the need will jump even more. Of course, there was more equipment but centralization here had to be more rigid, but on the other hand, wholesale trade and inter-rayon warehouses are what is now being done in Moldavia. The machine tool stock can then be reduced painlessly.

[Question] The unmoderated appetite for spare parts was caused by the low quality of agricultural equipment.

[Answer] We must engage especially persistently in specialization and cooperation. Everything is unusually closely related here. Take the repair of machine tools--it is done at each plant! Of course, the company repair is required. We plan to increase it twofold during the 11th Five-Year Plan. There are quite a few but if you look at specific volumes they will increase only to 40-48 million rubles. This is of course low.

[Question] And how many do you feel are required?

[Answer] I cannot yet say, this must be carefully analyzed, but I feel several times more. After all, not all equipment must be repaired at once but that which is effective. I feel that it is better for us to concentrate on service of new machine tools, especially those with ChPU, rather than on repair of general-purpose machine tools with manual control. This direction is only developing, there are many questions and they must be primarily worked on.

[Question] They talked much and hotly about service at the "roundtable." Although "soft goods" are counted in the sales volume, the director constantly has a hard choice: either become involved in service or produce machine tools. The choice is frequently predetermined.

[Answer] Probably some norm is also necessary here. I visited the United States in 1973 and I determined that approximately one-third of the activity of machine tool building companies consists of various types of service--repair, modernization or repair of machine tools. For example, an old machine tool is replaced by a more productive one and the old machine tool is resold to a small entrepreneur or is modernized. We have neither the taste nor interest in this activity, although it is extremely necessary. And we attempt to provide a plan for the entire "piece" at Gosplan, but do not leave free capacities for service. Corresponding norms are required. This is the duty of economic science. Some plants are meeting the needs for their own equipment relatively better and they have the capability of becoming basically



involved in service. Of course, this is a tedious matter but it must be developed.

[Question] Well, then, let's summarize the topic related to the machine tool stock.

[Answer] First, its structure is changing and there will be fewer general-purpose machine tools or rather those with manual control. Second, the fraction of progressive equipment in production will increase: that with CNC, machining centers, automatic and semiautomatic machines of all groups and automatic production lines. This has already been included in the plan. Third, the structure of forge-press equipment must be changed and blanks with minimum allowances must be produced. Fourth, production complexes, including equipping machine tools, forge-press machines and other equipment with automatic robot-manipulators, must be developed.

[Question] Now if you do not object, a word about tools. Specialists feel that if there are a sufficient quantity of good tools, then the efficiency of the machine tool is immediately raised by 25-30 percent.

[Answer] Of course! Taylor said that machine tool productivity relies on the end of the cutter. And we are making machine tools and fittings that cost much less per ruble of machine tool cost than in industrially developed countries. The specialized enterprises of Minstankoprom are now adequately meeting the needs for tools. The greater part of tools, especially special tools, is manufactured in tool shops of machine building plants.

The situation with materials, especially with tungsten, has become complicated during the past few years. And not only in our country but in the entire world. Whereas the rates of tool production were the same earlier, they have now decreased. The only way out is to convert to other materials--from welded-on cutters to multisided plates and to apply coatings of metal powders, to use ceramics and non-tungsten materials, including synthetic materials. Their use will increase several-fold during the 11th Five-Year Plan, but the specific weight is still insufficient.

[Question] How do you feel, is it efficient to make such a large number of tools at specialized enterprises?

[Answer] I am not a proponent of extremes. The truth as always is in the middle. Why do not large users of tools, for example, the truck-tractor industry, not make them for themselves? This is the practice throughout the world and not only in tools but in special equipment as well.

[Question] This means that you feel it is normal that AvtoVAZ [Expansion unknown], for example, has all production of its special equipment, including tools and fittings.

[Answer] And why not? Take the large automotive concerns: they provide themselves with this equipment, fittings and tools and also deliver more to the market.

[Question] Let us touch on makeup units. How do you, Lev Nikolayevich, evaluate the maneuver of the Ivanovo Machine Tool Building Association, which, having become interested in customers, receives currency from them, purchases ChPU systems, electric drives and miscellaneous items from well-known companies and delivers machining centers with these makeup units to their own, if one may say so, creditors. The plant has recommended itself well in the eyes of customers and has forced out foreign companies on the domestic market to some degree.

[Answer] This path is justified only during the initial stage of assimilating new equipment. Our country is a too capacious consumer to purchase everything. One can buy initially but then one must make everything himself. The machine tool builders must work here in close contact with the producers of makeup articles.

[Question] It is difficult not to agree with you, but judging by the statements of representatives of Minpribor at the "roundtable," the situation will not become much better with ChPU systems during the 11th Five-Year Plan.

[Answer] Besides Minpribor, Minelektronprom (Ministry of the Electronics Industry) has become involved in this problem and the machine tool builders should work more closely with it. But I generally have a special opinion with respect to makeup units. The machine tool builders should themselves have developers of systems and electrical equipment and--let us say small--production in order to develop experimental lots. After all, you can't intelligently order technology without this and you can't place requirements before related industries. When high-torque motors appeared, I attempted to convince the machine tool builders to have all this themselves. They said to me: "You are provincial," but now we are even so proceeding towards this and we are creating capacities at some machine tool plants in order to develop both ChPU systems and electric drives. But time has already been lost.

We have purchased and we will purchase not only makeup units but some special types of equipment as well. No other course is possible during the time of international sharing of labor. However, many of our internal problems are closely related to foreign trade.

And generally in order to purchase we must ourselves sell more and earn foreign currency and not behave like many--give me the currency and I will buy. And here we have large unutilized capacities for cooperating with companies on a compensatory basis. Our plants are just taking the first timid steps in this direction, obviously because the quality of Soviet equipment must be improvement. This is the number one problem--competitiveness.

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ANALYSIS OF STATE COMMITTEE FOR SCIENCE AND TECHNOLOGY YIELDS HOPEFUL RESULTS

Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian  
No 1, Jan 82 (signed to press 14 Dec 81) pp 135-144

[Interview with deputy chief of Machine Building Section, USSR State Committee for Science and Technology, B. P. Lyskov by special EKO correspondent I. Ognev]

[Question] Boris Pavlovich! The "roundtable" participants expressed serious concern that the technical level of machine tools and their competitiveness is not increasing as rapidly as was hoped. Both the equipment producers and consumers, including Stankoimport, agreed with this analysis.

[Answer] You say Stankoimport? Good, I will say a few words about the results of analyzing the technical level given by specialists of Stankoimport. We on the committee compared it to the analysis which was given by the GKNT [State Committee for Science and Technology] Committee.

According to instructions of the CPSU Central Committee and the USSR Council of Ministers, 30 committees were organized to evaluate the technical level of the machine building products of GKNT. The most prominent specialists and scientists were recruited. The GKNT committees reviewed 70 times more nomenclatures of machines and equipment than the specialists of the Ministry of Foreign Trade. It is natural that the reliability of our results is higher.

Of course, there are discrepancies and they are easily explained in some cases. For example, the KAMAZ truck is rated positively due to the condition of roads in our country. But to operate on European highways, it could be made two-axle rather than three-axle and metal consumption could be reduced because of this. With regard to analysis of our machine tools by specialists of Stankoimport, they reported their opinion on 18 models. We feel that their selection is random and it is impossible to make a general analysis of the products of Minstankoprom for these models. The opinions of Minvneshtorg [Ministry of Foreign Trade], GKNT and Minstankoprom agreed for six models. The GKNT committees evaluated more highly the technical level of one model. Minvneshtorg recommended modernization for 11 models, while GKNT and Minstankoprom committees recommended that they be taken out of production as obsolete. Production of 10 nomenclatures of these machine tools was stopped. One can conclude that the evaluation of the technical level of machine building

products given by GKNT committees is rather objective. The beginning of important and necessary work has been established.

Of course, the committees were unable to encompass the entire nomenclature of machines and equipment during 1980. This task was also not left to them. Even so, the committees evaluated more than 70 percent of the products of a number of machine building ministries, including machine tool building products. There are individual types of equipment whose quality is considerably lower than that of the best foreign companies. But the analysis yields hopeful results as a whole. The chief task of our machine builders is to continuously raise the technical level and quality of machines and equipment and create new designs to replace obsolete ones.

[Question] Unfortunately, obsolete products toward which the committees did not turn attention, intended for taking out of production, is not always really no longer being produced.

[Answer] In order that a product intended for removal from production no longer be produced, production must be uniformly prepared to produce new, more improved equipment. This is complex work which is drawn out over a prolonged period with insufficiently clear organization. I would like to note the positive experience of Minstankoprom in preparing for the production of new articles.

The two-year plan for preparation and assimilation of new articles is confirmed at the end of each year. This permits us to confirm a specific plan for replacing an obsolete product for production of a new one during the first planned year and to designate measures to prepare for production of new articles for the second year. Including timely ordering of makeup articles and materials and manufacture of complex castings and forgings. I feel that this system is rather successful at Minstankoprom for serial and small-series production of machine building articles.

[Question] And still the rates of renovating the machine tool stock are still not being corrected.

[Answer] This is a quite different problem. The committee feels that the rates of renovating the machine tool stock in the basic sectors of machine building are inadequate. In this regard we have suggested that the volume of equipment being replaced be brought up to at least 4 percent and by the end of the five-year plan, according to scientists, the rates of replacement should increase to 6 percent. However, because of outfitting new construction projects such as KamAZ, the actual renovation of the equipment stock at machine building plants will be less than recommended by the committee during the 10th Five-Year Plan. This cannot help but alarm us since technical progress cannot be supported in machine building by using equipment developed 20-30 years ago.

[Question] Gosplan refers to the fact that before increasing the rates of stock renovation, the deadlines for development and assimilation of new equipment must be reduced. And a customer will receive a new piece of equipment



whose efficiency is double that of an old machine tool or technology when, in short, you are obviously holding the cards. So are there plans during the 11th Five-Year Plan for accelerated introduction of new equipment and technologies.

[Answer] As I already said, these are two different problems. And their solution is related to different measures. It would be an error to replace one problem with another.

How is development and introduction of new equipment into industry being accelerated? GKNT is sequentially improving the planning of scientific and technical progress and is intensifying the effect of programs confirmed by the committee. Thus, whereas only development of experimental and experimental-industrial models was provided during the 8th and 9th Five-Year Plans by programs, the continuity and direct inclusion of equipment developed according to GKNT programs in the section "First industrial series of state plan for social and economic development of the USSR," in which tasks are assigned to the ministries for organization of serial production, were provided during the 10th Five-Year Plan.

Essential changes occurred during the 11th Five-Year Plan. The committee and Gosplan have confirmed the 160 complex programs developed by the ministries for the most important scientific and technical problems, including 40 special-purpose programs. The difference of special-purpose programs is that they are supported with all material resources, including capital investments, for development of production capacities. Of course, there will always be fewer special-purpose programs and we attempted to include in them the most important problems for development of the national economy.

[Question] I would like to turn now to organization of scientific research. Some large designers cite the fact that the collectives of scientists working in machine- and machine tool building--both in applied and academic science--are too specialized. This gives rise to complex problems, especially with an increase of unit capacities. Let us assume that one collective is engaged in metal, another is engaged in bearings and a third is engaged in lubrication. But when a unique assembly is planned, it turns out that preliminary calculations and experiments were somehow not taken into account because each collective looked at it from its own parochial view. Our organizational norms are such that it is almost impossible to invite different specialists from outside, even for one development, into a single collective. Moreover, the most important discoveries most frequently occur at the juncture of the sciences.

[Answer] It is difficult to answer in a few words to such a very unclearly postulated question.

Is it really necessary for all developers to be assembled under the same roof to develop an assembly or machine? First, we have a number of excellent sector and academic institutes, including those which were recently awarded the challenge Red Banners of the CPSU Central Committee and USSR Council of Ministers for development of new technology according to GKNT programs. I was present on 1 April 1980 when the Institute of Electric Arc Welding imeni Ye. O. Paton was awarded the Red Banner for success in the All-Union Socialist

Competition. These institutes are developing the latest engineering solutions and production processes which should be the basis in development of machines and equipment.

However, it is the business of designers to select the necessary engineering solutions and to develop an essentially new design of a machine. I would say that the chief designer should play a very important determining role here. If he does not have broad knowledge and experience and also organizational skills, this chief designer should be replaced. We value talented chief designers and will consolidate their prestige.

Prior to being appointed to the committee, I worked for a long time at the plants of Minavtoprom: at ZIL, at Miassa, at Mytishchi and later at NIITavtoprom [Scientific Research Institute of Technology of Automotive Industry]. I am a technician in work experience and was involved for a long time in preparation of production of new machines, including finishing of them. Once we encountered the fact that the bearings in the drive axles of a new vehicle were breaking down. This was detected in winter when the parts inside the axle heated up during operation while the crankcase was severely cooled by air during travel. The effect of the temperature difference on the parts of the axle led to breakdown of the bearings. Who should have been involved in analysis of this phenomenon? Institutes of the bearing or petrochemical industry? No! The design division of the automotive plant, the chief designer and his assistants should be.

Each organization should solve problems according to their own specialization. Take, for example, foreign companies. The West German company Goetze Werke manufactures piston rings for vehicles of many companies, while the Swedish company SKF delivers roller bearings. The design organizations of these companies can consult with each other but they themselves do not develop either engines or vehicles.

If the scientific research organizations of Minneftekhimprom [Ministry of the Petroleum and Petrochemical Industry] developed a good lubricating material, this is remarkable. But if the plants of the ministry did not organize production of materials--this is bad. The specialized scientific research institutes of the sectors can and should bring their own developments to introduction.

[Question] And how do you assess the order of development and introduction of new equipment which requires from its developers a mass of time for inter-agency coordination and settlement? According to some analyses, these causes and also the requirements of the Unified System of Design Documentation increased labor expenditures of designers and engineers on development of a complex of documentation for some large machine by 30-40 percent. And only the Ivanovo workers were permitted to reduce the bureaucratic marathon which new developments travel at tortoise speed.

[Answer] Both we and Gosstandart know that introduction of the YeSKD [Unified Design Documentation system] increased the expenditures of designer labor in some sectors. Even the former minister of the Machine Tool Building and Tool

Industry A. I. Kostousov appealed to the committee with a proposal to simplify this system. At one time, and we were among them, the question was posed to Gosstandart to simplify the technical documentation, especially for articles with serial and small-series production. Several meetings were held at Gosstandart in which machine tool builders also participated. As a result it was established that much can be done to simplify the documentation by the ministries themselves by improving sector standards. This is indicated by the experience of the joint work of Minstankoprom and Gosstandart. The ministries rather than organizations of Gosstandart mainly require collection of a large number of signatures when coordinating drawings. However, even Gosstandart must improve and primarily simplify the YeSKD.

[Question] How do you see the role of head institutes in the system of developing new equipment? Your investigations show that future developments occupy 8-10 percent in the topic of most of them, while the main mass of inventions that determine the rates of technical progress come into the sector from outside.

[Answer] I do not agree with the fact that the main mass of inventions that determine the rates of technical progress come into the sector from outside. Although these cases do exist in practice. The system of head institutes has given a good account of itself. But there are deficiencies in the work and this system must be improved. The CPSU Central Committee and the USSR Council of Ministers provided for the possibility as early as 1968 of developing the same engineering solution by different collectives of scientists and specialists. The head institutes do not always react objectively to analysis of outside developments. For example, the committee at one time criticizes the negative position taken by ENIIMS [Experimental Scientific Research Institute of Metal Cutting Machine Tools] on introduction of adaptive control systems for machine tools developed at the Moscow Machine Tool Building Institute, Minvuz [Ministry of Higher Educational Institutions], RSFSR. The criticism was beneficial. ENIIMS has now solved an important problem--it has developed automated sections outfitted with machine tools with ChPU and controlled from computers. The engineering decisions of both ENIIMS itself and borrowed solutions were used in the development.

I am opposed to the agency approach to our own and outside ideas. However, if you look you can find slight mitigating circumstances. It is now only psychologically difficult for some people to accept an outside idea, but the idea requires serious checking and a powerful experimental base. And it does not always correspond to their needs in many institutes. This is one of the reasons that delay the completion of scientific developments. After all, the machine building ministries in practice do not use all capital investments annually for development of experimental shops and plants.

Material and technical support of institutes and KB [Design offices] must also be better. We feel that the experiment conducted by USSR Gossnab is important. Proponents organized the supply of research and design organizations of Leningrad, Gor'kiy and Belorussia with materials and makeup articles within very short deadlines within 2-3 months rather than about a year after the applications were made. The committee requested USSR Gossnab to disseminate this method to other cities and rayons.

[Question] There were many complaints at the "roundtable" about makeup units, both about their quantity and technical level and organization of developments and production. What do you plan to undertake in this field during the 11th Five-Year Plan?

[Answer] One of the cornerstones of the planned measures are special-purpose and complex programs. The complexity of programs includes the fact that not only tasks to develop large and complex machines and equipment but development of makeup articles and materials as well are provided in them. Of course, there are still unresolved problems and unregulated relations between ministries. I recently saw an exhibition of robots of different ministries. In some the program control system had overall dimensions of a box for fancy work while others had one or two cabinets. This is what miniaturization of makeup articles means! Two ministries--Minpribor and Minelektronprom--must improve interaction so as to develop numerical program control systems on a modern level. One of the organizational forms of cooperation of different ministries and agencies in development of new technology are our programs. And we hope that this will have a positive effect on the technical level of the equipment which will be assimilated by Soviet industry during the next few years.

Thus, a wide range of problems related to increasing the technical level and competitiveness of metalworking equipment was considered in the materials of our selection. Manufacturers and consumers and representatives of science and administrative organizations that plan and coordinate the development of new technology expressed their own viewpoint. They noted that the problems planned by the party and government can only be solved by relying on the advances of science and technology of many sectors. The increase of the specifications of makeup articles for machine tool building must be accelerated. And this is unthinkable without sharp intensification of attention to its needs on the part of the electronics and electrotechnical industry and instrument building. Makeup units essentially determine the present technical level and competitiveness of metal-cutting equipment and this circumstance increases the responsibility of related sectors.

The major direction should become expansion of the output of machine tools with numerical program control, including multitool machines of the "machining center" type, special equipment oriented toward meeting the specific requirements of customers, automatic production lines and equipment with built-in microcomputers. Development of equipment on the basis of using new machining methods--electrochemical and electrophysical, plasma and laser technology--requires special attention of the sector.

The authors of the articles express concern about the rates of development of tool production which lag behind the rates of development of machine building and machine tool production, which leads to serious negative consequences. Only about 30 percent of tools is manufactured at specialized tool plants. Centralization and specialization of tool production must be intensified. The problem of producing measuring equipment, fittings and auxiliary tools for machine tools with ChPU is especially timely. This direction is being developed extremely slowly and does not have adequate production capacities available. The structure of tools being produced does not meet the needs of



machine building and machine tool building. The production of cutting tools from multisided hard alloy nonresharpened plates, from superhard synthetic materials and mineral-ceramics must be increased.

A great deal of attention is being devoted in selection material to the organizational and economic aspects of developing machine tool building. There are few specialized enterprises in our country to produce standardized parts and assemblies for metalworking equipment that have already achieved broad development in worldwide practice. The development of plants narrowly specialized in production of functional assemblies and parts for machine tools makes it possible to increase the mobility of machine tool production and to restructure it more rapidly to produce new models when requested by customers.

Orientation toward the customer was one of the central topics of the selection. As VAZ specialists suggest, it should be strengthened both legally and economically. There should be unified rules in Minstankoprom for deliveries of equipment by which all manufacturing enterprises would be under identical conditions and in which unified requirements could be placed on them. On the other hand, legal norms should be reinforced with economic incentives. The problem of "soft goods" merits special attention and planning and economic stimulation of services for machine tool servicing and for software for metalworking equipment with ChPU should be improved.

As was noted, the regulations on economic incentives for new equipment based on the decree of the CPSU Central Committee and the USSR Council of Ministers, dated 12 July 1979, on improvement of the economic mechanism is slowly being implemented.

Machine tool building plays a key role in increasing the efficiency of machine building production and in the final analysis of the national economy as a whole. The most important problems of its development, formulated in the decisions of the 26th Party Congress and the decree of the CPSU Central Committee and USSR Council of Ministers on increasing the technical level and competitiveness of equipment, should become the program of action both for the machine tool building industry itself and for all sectors and agencies related to it.

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